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A  
COURSE  
OF  
MEDICAL STUDIES:  
CONTAINING  
A COMPARATIVE VIEW  
OF  
*THE ANATOMICAL STRUCTURE*  
OF MAN AND OF ANIMALS;  
A HISTORY OF DISEASES;  
AND  
AN ACCOUNT OF THE KNOWLEDGE HITHERTO ACQUIRED WITH  
REGARD TO THE REGULAR ACTION OF THE  
DIFFERENT ORGANS.  
*A WORK CHIEFLY DESIGNED FOR THE USE OF  
MEDICAL STUDENTS.*

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BY J. BURDIN, M. D.

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TRANSLATED FROM THE FRENCH.

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IN THREE VOLUMES.

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### THE THIRD VOLUME.

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## MEDICAL STUDIES.

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### *HISTORY OF DISEASES.*

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#### CONVULSIVE AFFECTIONS.

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157. THE systems of organs, which are susceptible, as already shown, of different degrees of weakness, and which in this state exhibit various affections, may be also exalted or deranged in their action, so as to perform only with trouble and disorder the functions assigned to them. In this case they present phænomena of disease exceedingly numerous and varied.

158. The heart exhibits sometimes in its motions a very remarkable acceleration. During its rapid and irregular pulsations, it often strikes the ribs with such force as to produce a very sensible noise: this is frequently found to be the case after violent running.

The circumstances capable of producing palpitations of the heart are of two kinds :

One kind depend on an organic alteration of the heart, or of the large vessels; a dilatation of these parts; and on all causes capable of exciting any obstacle to circulation.

The other kind arise merely from a derangement in the nervous action of the heart. The latter ~~are~~ frequently remarked in individuals who have such a state of irritability, that, if it does not alone produce palpitations, it increases, in a singular manner, the influence of the other causes calculated to excite them.

In the case of palpitations which arise from an organic alteration of the heart, there is no hope of a cure. The paroxysms of those only which depend on a derangement in the nervous action of that organ, can be diminished or retarded, by removing the causes capable of accelerating the circulation.

When they arise only from great irritability of the nervous system, they require the application of general means suited to all kinds of convulsions. *Palpitations of the heart.*

159. In some individuals very much disposed or even subject to convulsive movements, and particularly in women, there sometimes suddenly comes on, for a quarter or half an hour, an impossibility



possibility of articulating, or at least with the usual tone and precision; the person makes fruitless attempts, as if to expel the mucous matter which obstructs the larynx. Sometimes an involuntary and incoercible flow of words takes place; an emission of the strangest sounds, passing abruptly from grave to acute, and vice versa, with astonishing discordance, and sometimes resembling the cries of different animals\*. The voice however is at length, sometimes, restored without any excretion. *Convulsions of the larynx.*

Impediment or abolition of the voice depends, in other cases, on palsy of the larynx.

160. The thorax is the seat of a peculiar affection †, which announces itself by a sensation of constriction, rather incommodious than painful; pain is felt along the sternum for a greater or less extent; and in general there is experienced, at the ~~same~~ time, in both arms, but rarely in one, a cramp towards the insertion of the great pectoral muscle, or in the fore-arm towards that of the round pronator. The paroxysms take place in consequence of causes exceedingly various, and they even vary much themselves, in regard to the

\* See Portal, *Mémoires de la Société Médicale.*

† London Medical Journal, vol. v.—Macbride's Introduction to the Practice of Medicine.

intervals and to the duration. Sometimes they last an hour or two; in some cases their return has been prevented by the use of wine or opium.

The striking influence of moral affections on the returns of this disease; its long duration, without any other derangement of the health; the state of the stomach; the relief almost always afforded by the use of corroborants, by riding on horseback or in a carriage, by varying the occupations and diverting the mind, indicate that this affection, which is merely nervous, does not arise from an organic alteration, and that it has its particular seat in the muscles of the thorax. It exhibits some analogy with chronic rheumatism. *Thoracic cramps.*

161. Among women, but more frequently among men, especially when very corpulent, is observed an affection which is often hereditary, and which seems to have its seat in the different parts of the organ of respiration.

This affection comes on by paroxysms, and exhibits a pretty regular progress. The patient, during the whole day which precedes the paroxysm, experiences great agitation, a slight headache, heaviness in the limbs, and a small degree of oppression at the breast. Some hours after dinner he becomes subject to great oppression, accompanied with a sensation of plenitude about the stomach, flatulencies,



flatulencies, distension of the epigastrium, and eructation of an insipid matter. On the approach of night a little hoarseness is felt, with a constriction of the bronchiæ and of the tracheal artery; during night, a heat which will not admit of the bed-clothes remaining on the breast, and a sort of convulsive cough. There is no expectoration, or it consists of serous matter in very small quantity. The sensation at the stomach is lessened by cold beverages, and particularly by water.

One or two hours after midnight the paroxysms seem to commence by an increase of indisposition; respiration, exceedingly difficult and slow, is performed with a sort of hoarse, hissing noise, and renders it necessary to assume a vertical position. The diaphragm seems to move only with great difficulty, and to be drawn back into the breast by the mediastinum. The patient experiences a sensation of constriction in the lungs, and imagines that these organs are contracted and pushed towards the upper part of the thorax. He makes violent efforts to enlarge his breast, and is incapable of coughing, spitting, or speaking with freedom. He experiences excessive heat; the pulse is quick, close and unequal; the feet and hands are cold; the face is sometimes blackish; the eyes sparkle, and discharge involuntary tears, which sometimes tinge the cheeks yellow. The lips are disposed in a form as if about to suck.

Sometimes the patient gets up, places himself at the window, whatever be the season, and respire, while standing, with more facility. In some cases, the distension of the abdomen seems to decrease; the difficulty of breathing is lessened; and there comes on an ample evacuation of faecal matters and of flatulencies, which affords relief.

In general the symptoms continue for several hours, and even sometimes to a pretty late period in the morning. After a little sleep, however, respiration is less laborious; the act of speaking and the cough become less difficult. Sometimes a mucous expectoration takes place, and the remission is then always more sensible. The urine is less abundant, more highly coloured, and generally sedimentous. During the whole day the patient experiences a constriction at the breast, and a difficulty of breathing when he assumes a horizontal position, or makes any movement. After dinner flatulencies take place; he becomes drowsy in the evening, and the difficulty of respiration gradually increases. Sometimes, however, respiration is pretty free, and sleep tranquil for a part of the night; but from midnight till two in the morning the patient is suddenly awaked by an attack of a second paroxysm, similar to the first.

The paroxysms are thus continually renewed for four or five nights; expectoration daily increases in the morning, and the remissions are proportionally

tionally less sensible. Sometimes the paroxysm is preceded only by a little drowsiness towards the evening. In this case it continues not more than two or three days, and when the patient is up he expectorates a serous matter. But in the case of the greatest intensity the disease continues for four or five days, with the usual exacerbations every night. The expectoration does not begin till the third or fourth day; at first it is in small quantity, becomes progressively less viscid, white or yellowish, and is sometimes marked with bloody striæ.

A first attack of this disease gives reason to presage, in an infallible manner, periodical returns during the remainder of life. Sometimes these returns seem to be produced by great heats, and violent emotions; by certain odours, smoke, snuff, dust, &c. and by every thing capable of abating or accelerating the movements of the breast.

Some individuals experience more frequent accessions in summer, and particularly during the oppressive heat of the dog-days; others are oftener and more severely afflicted in the winter. But at this period the disease, for the most part, is accompanied with a catarrhal defluxion of the bronchiæ. In all cases, however, the patients are speedily affected by sudden changes of temperature\*.

Some

\* Floyer, who kept a very exact journal of his disease for seven years, relates, that these paroxysms were more violent, and

Some find themselves better in the air of great cities; others in that of the country; but almost all prefer the dry free air of low districts to that of the mountains. Damp, foggy air in general is prejudicial to them, as well as damp habitations in marshy places. They are fatigued by heat, but can very well endure cold, and even a pretty intense degree of it; which sufficiently indicates that the atmosphere best suited to them is always that most abundant in oxygen, little charged with moisture, and which is not subject to too great or too frequent changes. The inspiration of air with an increased proportion of oxygen may be useful to them.

Light animal food and water are much better suited to such persons than flatulent aliment and spiritous liquors. Riding on horseback or in a carriage, and sea voyages, afford relief.

Emetics sometimes have appeared useful in this affection, especially when it is catarrhal; when given before the accession they sometimes prevent it.

This affection, in general, produces no derange-

ment  
longer duration, in summer than in winter, but particularly in the month of August, and that the expectoration then became thicker. The return of the paroxysms took place for the most part in the course of the three days preceding or following the full or the new moon, and sometimes also towards the quadratures.—Van Helmont also observed a relation between the paroxysms and the phases of the moon.

ment in the rest of the organization ; and there are instances of people who have been subject to it fifty years, without any other inconvenience.

The accessions, however, rarely recur often, for a considerable length of time, without producing a general emaciation. In some young persons it has been seen to terminate very soon by a pulmonary phthisis; sometimes also it produces hydro-thorax.

It is probable that the perturbing system of treatment is that best calculated to effect a complete cure of this disease, especially in the commencement, and before the paroxysms; by exciting either in the stomach or in the sides of the thorax a repeated and continued irritation, capable of removing that of the organs of respiration, which produces the spasmodic or convulsive symptoms of *asthma*.

162. In persons subject to convulsions, and to all those causes by which they are produced, there comes on sometimes by paroxysms an affection of the œsophagus. Deglutition is difficult or impossible, and this symptom is accompanied with a contraction or stiffness of the tongue, of the larynx, and of the whole neck; a suffocating constraint, and a sensation as if some body had stuck in the fauces: sometimes there is also a transitory or permanent aphonia.

In other cases deglutition at first appears to be free, but the substances swallowed stop at a particular



cular point of the œsophagus, and for the most part near the stomach. Warm liquors pass with more freedom than cold; the patient at the same time experiences a pain along the spine, nausea, frequent efforts to vomit, flatulent eructations, and throws up limpid mucus with the matters which have been swallowed.

Sometimes the two series of phænomena here enumerated are observed, either simultaneously or with constant or irregular alternations. In this case, the patient experiences a sensation as if some body obstructed the œsophagus; and of flatulencies ascending and descending, without eructation taking place. These varieties seem to depend on the different parts affected.

In general, these affections come on by paroxysms, and vary very much in regard to the interval, strength and duration. At the same time there is often a coldness in the extremities of the limbs, and particularly the feet; sometimes trembling, suppression of the stools, abdominal spasms, palpitation of the heart, &c. This *spasmodic affection of the œsophagus* is very often accompanied by the other convulsive diseases.

There are other obstacles to deglutition, which arise from,

1st, Atonia or palsy of the œsophagus. In this case, solids pass with more ease than liquids (*Fabr. de Hilden*). The latter run along the larynx, and  
are

are sent back, through the nostrils and the mouth with danger of suffocation. This frequently takes place in the advanced stage of continued pernicious fevers.

2d. From an acute phlegmasia : anginae, &c.

3d. The presence of some voluminous body stopped in the œsophagus; a wound, ulcer, tumour, or excrescence in its sides; a considerable swelling of the glands of the neck; a scirrhus state of the œsophagian orifice of the stomach; a luxation of the os hyoides.

163. By a convulsive contraction of the stomach, assisted by a sudden shock of the diaphragm and of the abdominal muscles, the matters contained or affluent in the stomach, the duodenum, and some other intestines, are sometimes thrown up in the act of vomiting.

This disease arises from a nervous affection, a phlegmasia of the stomach, different irritants introduced into that organ, or which develop themselves in it.

This affection is only symptomatic in some acute diseases, and in some phlegmasiæ of the abdominal viscera, &c. It is often produced by a contraction, a scirrhus tumour, or a cancer of the pylorus and of the duodenum, a strangulation or stricture, nodosity, intussusception or adhesion of  
the

the intestines, and by every obstacle to the free course of the matters in the intestinal canal, &c.

But the vomitings often appear to be entirely analogous to convulsive affections, and in that case may sometimes be excited by the influence of the imagination. This influence results from the aspect of the vomiting, and from all those objects and circumstances which may recall the remembrance of it. In some persons it may be produced several times by an accidental cause, and then continue by the force of habit, notwithstanding the absence of the cause which at first produced it. It then always exhibits periodical or constant returns.

164. Peyer relates several examples of persons who had the faculty of bringing back into the mouth the aliments they had swallowed, in order to masticate them at leisure (*De Merycologia*). In some individuals this habit, instead of being an inconvenience, appears to be agreeable, and to get rid of it, nothing would be necessary but a determined resolution. In others, it is entirely involuntary, and seems to arise from a real convulsion of the stomach, irritated by the presence of aliments introduced too suddenly, and in too large quantity. It is, in particular, after an excess of gormandizing that this species of *rumination* is renewed.

165. There



165. There is an instantaneous and reiterated affection, which consists in a sudden shock given to the breast and abdomen by a spasmodic contraction of the diaphragm. It is accompanied with an acute sound, stronger or weaker, which appears to arise from an explosion of the air contained in the stomach and the œsophagus.

In certain cases, *hiccup* is merely a symptom of some derangement of the gastric system, such as colic of the stomach, the intestines, the kidneys, &c. a strangulated hernia: it is also a troublesome symptom of some acute diseases in an advanced state.

Hiccup, in general, results from a momentary irritation of the stomach, when that organ has suddenly received too large a quantity of aliments or of alcoholic liquors. It appears to be produced also sometimes by an instantaneous irritation of the œsophagus and of the diaphragm.

Hiccup sometimes is really spasmodic; and, without seeming to result from any cause, may continue a long time by a sort of habit\*.

Though hiccup, for the most part, is frequently renewed, it is scarcely an indisposition. While it takes place, a slow and long inspiration, sneezing purposely excited, a sudden surprise, unexpected news, a fright, and every powerful distraction, are

\* Tulpius, Riviere, Fernelius, &c. speak of a hiccup of this kind which frequently returned for several months.

sufficient to remove it ; which might induce a belief that in these cases it is merely a spasmodic affection.

In the last place, when hiccup is the symptom of another disease, the latter alone deserves attention.

166. There is an affection distinguished by a dull or acute pain in the epigastrium, with a distension or contraction of the stomach, flatulencies, eructations, vomiting, &c. The general indisposition and state of the pulse depend on the intensity of the disease. This disease seems to proceed from a spasmodic or weak state of the stomach, which in many circumstances varies. The principal variations we shall here describe. Sometimes this disease arises from an affection of the pylorus ; from the action of emetics, violent purgatives, poisons, &c.

In persons below the middle age, and in those even who have not attained to puberty, but particularly in women, it sometimes comes on spontaneously. It manifests itself, for the most part, before meals, by pain with a sensation of constriction in the epigastric region ; the stomach seems to be strongly pulled towards the back, and the body leans forwards ; which in some measure diminishes the uneasiness. After a certain time the eructation becomes easy, or rather there flows off a large quantity of aqueous liquid, sometimes acid, and at  
others

others perfectly insipid. After some eructations in close succession, the pain decreases and entirely vanishes.

This transient inconvenience, which however is apt frequently to return, is in general more troublesome than painful. It terminates spontaneously ; is met with in our climates, and was observed by Linnæus in Sweden. *Cardialgia sputatoria*.

Feeble persons, convalescents, and chiefly women, and those in particular whose organs of digestion are exhausted by the long use of tepid aqueous beverage and aliments, or by the abuse of different stimulants, are very much subject to this disease, which is readily renewed by violent mental affections, strong sensations, and by certain kinds of food. In these cases they experience, some hours after meals, towards the epigastric region, distension or tumefaction, dull or acute pains, with suffocation, and great sensibility to the touch in the region of the stomach : eructation of acid or sweetish matter then takes place, and sometimes vomiting ; which affords relief. In some cases this state is accompanied by a coldness of the limbs.

This disease sometimes depends also on convulsive affections, and accompanies them. It is then characterized by an acute pain in the stomach, with anxiety, shortness of respiration, and efforts to vomit : shivering, a sudden prostration of strength,  
and

and a sensation of approaching syncope, at the same time take place. The pain, which at first seems to arise from the pylorus, extends to the rest of the stomach, and towards the spine. Sometimes a tumour, nearly of the size of an egg, manifests itself a little to the right of the sternal appendix: eructation produces a slight relief. During the greatest violence of the disease, the limbs are cold, and the pulse is small and confined. At length heat is restored, with an universal sweat; the pulse becomes large and soft, and the pain gradually ceases.

The numerous relations which the stomach has with the other parts cause this organ frequently to participate in their derangements; so that this disease, which we have often seen to be differently essential, is very often only symptomatic. It may therefore be determined by an irritation arising from a calculus in the urinary or biliary canals: it often precedes febrile and gouty attacks; it forms the prevailing symptom of a variety of intermittent pernicious fever; and it accompanies the interversion of a great many diseases, such as dysentery, gout, &c. *Colic of the stomach, Gastrodynia.*

167. The intestinal canal is the principal seat of a disease which appears to be entirely spasmodic: it is characterized by acute pains in the abdomen, which cease and are renewed at very short intervals.

In

In *intestinal colic*, the pains are more acute when they take place towards the umbilical region, and seem to proceed from the small intestines. The patients for the most part experience a sensation of distension and twitching, which proceeds from some point of the intestinal canal, and extends by little and little. The intestines are in a state of constipation, which gradually increases, so as to prevent all escape of the flatulencies. The pulse is always small, hard, close, and convulsive.

The disease, in its progress, exhibits intervals, very much varied, of calmness or simple remission; and at its highest degree there often come on shiverings, tremor, great agitation, extreme anxiety, nausea, vomiting, at first of mucous, then of bilious, and lastly of stercoraceous matter. Sometimes hiccup, delirium, convulsive movements, cold sweats, syncope, &c. are observed, and, in some cases, vesical tenesmus.

In some individuals a flatulent tumefaction of the belly takes place, with extreme sensibility to the touch; a sensation of tension and pain in the stomach, efforts to vomit, and flatulent eructation which affords relief.

Others experience oppression of the abdomen, a retraction of the navel, violent contraction of the abdominal muscles, which become hard, and exhibit their form beneath the integuments; a con-



friction of the anus, which does not admit the introduction of a clyster. In this case the belly is not painful when touched, and sometimes even the pain is diminished by pressure.

The severity of the disease depends on the intensity of the symptoms, and particularly on the force of the constipation.

The colic generally ceases on the appearance of some phænomena of particular affections: such as nasal and hæmorrhoidal hæmorrhagy, cutaneous eruption, fit of the gout, diarrhœa, &c. pains in the joints.

Sometimes fever and violent heat come on; the pulse is hard, frequent, and close; the patient experiences unquenchable thirst; and violent, constant, and fixed pains indicate a local phlegmasia. (See that article.) In some cases, then, a sudden cessation of the pain, universal calmness, prostration of the strength, weakness of the pulse, cold sweats, foetidity of the mouth, and frequent syncope, announce a gangrene.

This disease is most frequent among children, old persons, women, and weak individuals of great sensibility. The habit of a slight constipation, the use of debilitating food, such as aqueous, sweet, saccharine, flatulent, &c. vegetables, chiefly produce a disposition towards this affection. It may be occasioned by exposure of the feet to cold or dampness;

dampness; by a violent fit of passion, particularly in youth; by excess at table, and by many other causes.

It is the effect also of an organic derangement in the intestines; such as the obstruction of a point in the alimentary canal by a ball of hardened excrement; (*Hoffmann, Henry de Heers,*) or by a large calculus, a strangulated hernia, a callosity, a scirrhus, (*Kerkring, Baillou,*) a cartilaginous ring, the torsion of a part of the intestines, their intussusception, a ball of worms entwisted together (*Henry de Heers*).

This disease is a constant symptom of hypochondriasis. It frequently succeeds also some essential affections, accompanies others, and appears to be the result of every cause which produces a sudden derangement in the usual progress of a phenomenon of health or of disease.

It succeeds an interruption of the gout, menstrual and hæmorrhoidal suppressions, &c. It accompanies the existence of a calculus in some parts of the urinary or hepatic system, the labour of dentition, &c.\*

### Colics

\* The colic which succeeds or accompanies any derangement may arise from the cause of that derangement, or from some foreign cause, and in either case the irritation produced on the intestines may be too strong to put an end to the concomitant disease. Colic may be produced also by every cause which disturbs the usual progress of a phenomenon of health or of disease. But, in

Colics differ very much from each other, in consequence of the different causes by which they are produced ; of the seat of the pain, and the severity of the symptoms. On these bases, however, no very striking distinctions can be established ; but there is one which exhibits a prominent character, and a constant progress, which renders it of importance to give a detailed history of it.

168. This colic, which has been known at Paris for more than two centuries, has been observed in Germany, and described by Dehaën and by Stoll ; it has been observed also at Madrid, at different periods, and recently by Lurufiaga. In all these places, and at all times, the description of it has been fundamentally the same. It has always been ascribed to a certain action of preparations of lead, swallowed, or received into the bronchiæ. Citois has described a colic which took place in Poitou in 1616, and Huxham another, which took place in

all these circumstances, the disappearance of the first affection ought not to be ascribed to the transportation of a material and morbid affection to the intestines, but to an interruption of the nervous affections, occasioned the one by the other : and it is as ridiculous to say that a colic is produced by the transportation to the intestines of a gout which has disappeared, as it would be to assert, that the colic which follows or accompanies suppression of the menstrual flux, or the presence of a calculus, is produced by the transportation to the intestines of the uterine flux, or of the urinary and bilious calculus.

Devonshire



Devonshire in 1724, both very analogous to the one in question. The former of these writers ascribes the one in Poitou to the four wines of that country; and the latter, the one in Devonshire, to the cider, which that year had been exceedingly abundant. Sir George Baker, however, has since asserted, that the colic of Devonshire ought rather to be ascribed to the lead employed in the mills and cisterns being dissolved by the acid of the apples, and becoming mixed with the cider. *Journal des Savans*, Jan. 1768.

This disease, however, attacks in particular workmen employed in lead manufactories, who are exposed to the fumes arising from that metal; and those who drink liquors which hold it in solution. But it appears certain that, independently of the influence of the lead, a peculiar disposition or aptitude, which it is impossible to determine, is also required. Stoll says, he remarked in almost all the patients attacked by this disease a certain appearance in the face and eyes, which presented something maniac, an air of stupor, an habitual thoughtfulness, &c.

This affection announces itself suddenly, or in a slow manner, by extraordinary dejection, languor, watchfulness, loathing, a derangement in the stools; wandering pains take place in the epigastrium, with a sensation of heaviness in the stomach immediately after meals; the stools are rare, hard, and in small bits. There are observed afterwards an

air of intoxication, vertigo, stupor, and dimness of sight : all these symptoms are temporary, and frequently recur, &c.

Soon after the constipation increases ; in which case the person experiences excruciating pains in the abdomen, a sensation of tearing and twisting in the intestines, which is renewed at short intervals. The pains, which in general are fixed towards the œsophagian orifice, or the whole abdominal region, follow the direction of the ureters towards the bladder ; affect the scrotum, the thorax, and even the limbs, like an acute rheumatism. The pains for the most part are not increased by touching ; and pressure of the abdomen very often gives relief. At other times, however, the epigastrium can scarcely endure the lightest covering. Sometimes the belly is soft ; but in general it is hard, distended and uneven ; the navel is turned round, and shrinks towards the spine, with hardness and tetanic contraction of the abdominal muscles. A spasmodic constriction of the intestines, which, under the integuments, exhibit the appearance of hard rolls, is observed ; often a vesical tenesmus ; sometimes a shortening or almost sudden disappearance of the penis ; the scrotum becomes alternately contracted and relaxed ; the testicles experience a retraction, or sort of painful rotation, &c.

During a great part of the disease the patient

very often experiences vomiting, sometimes with hiccup. He has no stools, notwithstanding the use of injections or purgative draughts; or there are voided only a few very hard globules, with exceedingly painful tenesmus, and a little bloody mucous matter. When frequent and copious stools take place, they always afford relief.

During almost the whole course of the disease the patient exhibits an astonished, thoughtful, or even maniac air; his mind is restless, turbulent, impatient and fickle.

At the commencement the pulse is nearly in its natural state; during the progress of the disease, it is sometimes frequent and unequal, and the diminution of the pain is always preceded by a slight febrile paroxysm, which terminates in a copious sweat. Towards the termination, a gentle motion, followed by the dejection of hard globular excrement, or even of viscid matter, mixed with mucous flakes, is perceived in the abdomen. The pains then slowly decrease; the appetite is restored only gradually; the stomach becomes considerably swelled after meals; and the nights continue to be restless.

Sometimes the disease produces a sensation of curvature accompanied with weakness, cramps, or shooting pains in the limbs, tremors, or even muscular impotence, pains in the breast, and transient difficulty of respiration.

In some very severe cases the vomiting is alarming, and produces the rejection of stercoraceous matters, with hiccup: syncope, cold sweats, partial or epileptic convulsions, take place; and if the patient escapes death, the pains are then continued for several weeks, with intervals of remission.

In the course of the disease, palsy very often takes place in some of the limbs \*, particularly in the arms, the hands, and in some of the fingers, but rarely in the pelvian limbs, and never unless the thoracic be affected also. The palsy only suspends the muscular action, without injuring sensation, and in different cases exhibits shades exceedingly varied, from simple tremor, heaviness and inaptitude for motion, to complete paralysis. In general, there always remains a slight degree of contractility, at least in the flexors. In certain cases a weakness of the voice is observed, with hoarseness, aphonia, difficulty of respiration, amaurosis, deafness, &c. and various transient but repeated symptoms.

The palsy may take place at different periods of the disease †.

In

\* According to Stoll, fifteen patients exhibit only one example of palsy, and it is a little obstinate only once in twenty-five cases.

† It was after this palsy that Dehaën observed a deltoid muscle which to the touch presented nothing but a membranous substance, and all the muscles of the arm and fore-arm, with the  
fat,

In a considerable number of patients, and especially those who have been already severely affected at different times, there arise on the backs of the hands tubercles as large as peas, at first painful, which yield to the pressure of the finger, and speedily resume their former state. These tubercles, which afterwards acquire hardness, and a character of indolence, appear generally on the attack of the disease, and sometimes even before the appearance of any other symptom.

This disease varies in regard to its duration, from a few days, for example, to several months; sometimes it continues years, and in this case it is more troublesome by its obstinacy than its violence. In general it is not very mortal.

The body, when opened, exhibits organic alterations, which may throw some light on the nature of the disease. Constrictions or strangulations are found in several parts of the intestinal canal, of the duodenum, the ilium, the cœcum, and the rectum.

fat, the skin, the tendons, and nerves, were converted into a sort of pulpy ligament. At the same time, several persons affected by the same palsy had the flesh of the arm more or less flaccid.

In the body of a man who had died of the leaden colic, Hunter found the muscles of the arm and hand, which before death had been emaciated, as white as cream; the fibres of them were distinct, but drier than usual. Salzmann, in the *Journal des Savans* for 1735, gives an account of a man forty years of age, in whom a great many muscular portions of the right thigh and leg were found converted into fat.

These



These strangulations are often separated by very ample dilatations. Sometimes these contractions disappear immediately after death ; at other times they continue two or three days. It evidently appears that, on the termination of the malady, they are entirely dissipated, since a relapse seldom occurs without a new cause. It is, however, to be presumed that they subsist, or are renewed, when the patients continue to be frequently subject to slight colics and hard globular stools. In some cases, portions of the intestines are found shrunk, and almost converted into ligament. In a word, phlogoses have been found in the mesentery, in the intestines, in the stomach, in several of the abdominal and thoracic viscera, &c. with extravasated blood, echymoses, and vibices. (*See Bordeu*). There is reason, however, to believe that these alterations have no relation to the most common cases; but only to those rare circumstances under which the disease, when carried to an extreme degree of violence, brings on phlegmasia, and perhaps even a gangrenous and sphacelous state.

It is evident that this disease has its principal seat in the intestines, and the intensity of the local symptoms gives rise to the other remote accidents.

The particles of lead (in all probability oxidated) which produce this affection, seem to exercise an immediate action on the organs of digestion in persons who drink liquors holding this metal in solution.



tion. When workmen, however, are habitually exposed to respire air in which some of it is suspended, it is not probable that the disease arises from particles introduced into the stomach by deglutition : it is much more probable that the first action of the lead is exercised on the bronchial surfaces ; and that it proceeds to the intestines, on which this metal seems to have a specific action. Several substances exercise a similar action, and in a similar manner, on the same organs, whatever be the parts which they affect. The viscera of the breast are often affected in this disease, since there are observed hoarseness, aphonia, cough, a spasmodic difficulty of breathing, &c.

Two methods, which seem to be diametrically opposite, and which have been attended with equal success, are employed in the treatment of this disease. This peculiarity is worthy of notice, as it is of importance to the history of the organization.

169. One of these methods, founded on the general principles of medical observation, sees in this disease, as well as in others, a progress which it is proper to respect ; and employs only mild and simple means, calculated to promote a favourable termination.

The other, entirely empiric, which is more active and decisive, consists in violent emetics, exceedingly strong purgatives, repeated without distinction

stinction every two days. This method is that followed at present in the *Hôpital de la Charité*, only that a slight dose of opium has been added. It is supposed that this method must be attended with speedier success, as violent emetics and purgatives, the principal action of which, in regard to the intestinal constriction, can be exercised only on the stomach, produce in it an irritation sufficiently strong to remove the spasm of the intestines, which opposes the evacuations. But it may be readily seen what opinion ought to be formed of this method, when it is known that it is employed with the absurd and ridiculous intention of *opening the belly and forcing the barrier*; and whether there is not more reason to be alarmed on account of the accidents it may produce, than to be confident in the advantages likely to result from it. Stoll having observed that momentary success only was obtained, in slight cases, by emetics and purgatives, and that the disease was almost always exasperated by them, had at length recourse, in the most desperate cases, to opium, contrary to the advice of Dehaën: he obtained a cessation of the pains and vomiting; had spontaneous stools, and then opium became his purgative\*. *Metallic colic, Colica pictonum, Rachialgia metallica.*

170. The

\* In this disease opium, as we have seen in tetanus, may be administered in strong doses without producing sleep. Stoll gave

170. The different organs of motion may experience a convulsive affection, which takes place by paroxysms, and continues a short time. This affection, for the most part *symptomatic*, is sometimes *essential*.

In the first place, it accompanies some considerable derangements. It comes on, therefore, after an irritation produced in any part in consequence of wounds, fractures, luxations, tumours, &c.; by tension, compression, the puncturing or laceration of some of the nervous reticulations; after an organic læsion of the brain, the collection of any fluid in its cavity; an affection of the uterus; the existence of calculus. This disease may be the effect also of a first difficult menstruation, of parturition, of the presence of poison in the stomach or elsewhere, and of worms in the intestines. In children it frequently accompanies the attack of eruptive fevers and dentition; in adults it precedes, and sometimes follows, the sudden suppression of a natural or morbidic\* secretion; that of all organic functions which are habitual†, or which have be-

six French grains with six grains of camphor in twenty-four hours. He even carried the dose to thirteen grains. Dr. Gendron gave so much as ninety-six grains with six ounces of syrup of diacodium in three days, without producing sleep. *Rec. périod. de la Soc. de Médecine*, vol. ii.

\* Suppression of the menstrual flux; of diseases of the skin of a long standing; of old ulcers and emunctories, &c.

† Indigestion, disappearance of the gout, &c.

come

come so ; in a word, any sudden interruption in the natural progress of the vital operations, and in that of acquired habits. It is then probable, that what is here called disease is, in many cases, only an effort of vitality to recover from some sudden derangement, and to attain to the complete use of its functions.

When this disease is essential, it affects chiefly the feeble and delicate children of cities, descended from parents of a highly irritable constitution, and long exposed to the empire of violent passions. It is common also to adults, and particularly women endowed with an excess of sensibility, and easily agitated by the slightest causes; always extravagant in their affections, and who proceed with astonishing rapidity from one very striking emotion to one directly opposite. (*Mutatur in horas.* HORAT.)

Persons subject to this disease are generally loaded with a great deal of flabby and entirely lymphatic corpulency. Sometimes, however, they are pale, meagre, dry, and, as we may say, all nervous; their sleep is generally restless; they are troubled with frightful dreams; have a variable appetite, rare stools, and much rarer sweats.

The paroxysms seem often to be determined by some violent mental affection; at other times they come on spontaneously, without any apparent cause: their duration, as well as the length of the intervals, is exceedingly various.

Some

Some authors think they have sometimes observed, in the return of the paroxysms, a regular periodicity, and even a coincidence with the phases of the moon.

On the approach of the paroxysms are observed: sleep not profound, interrupted by groundless fears; sudden movements in the fingers, the arms, and legs; the eyes fixed or wandering; the pupils dilated, and some muscles of the face agitated by convulsive motions: soon after, coldness, a pricking in the exterior parts, and particularly in the feet, a sensation of cold water running along the back, yawning, palpitation of the heart, anxiety in the præcordia, abdominal spasms, universal tremor, pulse hard, unequal and confined. All these symptoms exhibit great anomalies, and the attack is often sudden.

The paroxysm announces itself by sudden agitation in different parts of the body; contorsion in various directions; extension, but oftener flexion of the limbs, which proceed a great way beyond the usual limits; sometimes by luxations or fractures. The eyes are sometimes closed, sometimes open and projecting, fixed or violently agitated; spasmodic movements of the jaw, cheeks, and mouth take place; the tongue is thrust out between the teeth, and in that state is often bitten. The vocal organs exhibit convulsive affections also, and  
in



in this case loss of speech, and even of voice, is the consequence ; respiration is sometimes short, with symptoms of suffocation : at length palpitation of the heart and violent cardialgia are observed ; severe griping pains in the belly, and costiveness ; the urine ceases to flow, or becomes highly limpid.

There is no part of the body which may not be affected, either singly, or in conjunction with a greater or less number of others. In some cases the spasms are confined to one part only ; in others they proceed suddenly from one part to another, without any regular or certain progress. Some individuals remain in the same position in which they were when attacked by the disease, or at least assume that nearly which gives them most satisfaction ; others fall down, and exhibit every appearance of epilepsy,—only that the intellectual faculty remains, and sensation is not annihilated. In general, there is no foam at the mouth ; the patient is conscious of what takes place around him, and remembers it, at least in a confused manner.

In general, the muscles possess a contractile force, which resists the greatest efforts ; but at the end of the paroxysm they fall into a state of perfect relaxation ; the patient experiences extreme languor, a sort of fainting, and sometimes profound drowsiness. In some the termination of the paroxysm is announced by flatulent eructations,  
abundant



abundant vomiting of mucous matter ; bloody or mucous evacuations from the nose, uterus, hæmorrhoidal veins, &c.

In many individuals of a constitution exceedingly weak and sensible, this disease seems often to arise from the sudden impression produced by the sight of a similar state ; by the dread of the same evil ; or by the remembrance of this affection in a person subject to it, but chiefly from the irresistible tendency to imitation.

A paroxysm of convulsion, in general, exhibits nothing in itself dangerous, especially when the constitution is sound, and when it arises from an accidental cause. But if the individual is weak, or if the first cause continues, and is frequently repeated, the multiplicity of the paroxysms renders the malady in some measure habitual. These paroxysms, frequently repeated in this manner, progressively exalt the sensibility, and dispose the individual for receiving the influence of a multitude of new causes ; so that the paroxysms approach each other more and more, merely for this reason, that the individual has already experienced a great many. It is thus that repeated efforts to sham convulsions at length give rise to real and sometimes incurable movements of this kind.

This convulsive habit often brings on, and is accompanied with, hypochondriasis, melancholy, ma-

nia, &c.; and death at length takes place by a fit of apoplectic epilepsy.

Convulsions which succeed a violent hæmorrhagy, any immoderate evacuation, or fevers, are much to be apprehended. On the other hand, when they precede eruptive fevers, and some other diseases, they appear to be advantageous. *Convulsions.*

171. There is one disease which consists essentially in a spasmodic contraction of the muscles.

It attacks individuals of both sexes, of all ages, and in all climates, but particularly in warm countries, near the sea, exposed to damp winds; in marshy districts, where the temperature is subject to great and sudden variations; at seasons when these variations are more sensible, and in the time of storms accompanied with cold rains.

It is very common, violent, and mortal in America, where it frequently attacks the negroes, and particularly the children, soon after birth.

An affection very analogous is found in the cramp, which is common and as it were endemial in Java and Ceylon.

This disease, which is very prevalent at Surinam, seems often to arise from a violent mental affection, or concentrated anger. This species, common at Beziers, and in part of the south of France, is distinguished there by the name of *Mal de l'âme*.

Observation

Observation seems to indicate as the causes of this disease: strong mental affections; the sudden impression of intense, and particularly damp cold after a hot temperature; the presence of worms in the intestines: it comes on also in consequence of wounds or surgical operations, and in this case does not manifest itself till the end of some days.

The development of this disease is, for the most part, slow and gradual. There first comes on a sensation of stiffness towards the nape of the neck, which by degrees increases, accompanied with constraint and pain in moving the neck. Deglutition afterwards becomes difficult, and then impossible: in this case there is often a violent pain at the bottom of the sternum, which extends thence to the back, with a sudden contraction of the cervical muscles, which strongly pull the head backwards. At the same time the jaws have an insuperable tendency to approach each other. The disease sometimes remains at this degree, and is known by the name of a *locked-jaw*. *Trismus*.

In other cases are observed frequent returns of sternal pain, cervical and maxillary spasms; and during the further course of the disease a spasmodic rigidity of the dorsal muscles takes place, and the whole body is thrown backwards (*Opisthotonos*). The limbs then become stiff and inflexible; the sides of the abdomen appear very hard, and as if drawn back by the contraction of the muscles of

that cavity. In the last place, a violent contraction takes place in the flexor muscles of the head, the neck, and the trunk (*emprosthotonos*), an extension and uniform rigidity of the trunk and limbs, so that, in raising the feet or head, the whole body stands erect like a plank : the arms and fingers are the last parts which become stiff. Towards the end of the disease, the tongue is sometimes thrust with violence between the teeth ; all the muscles seem then to be affected ; the forehead becomes corrugated ; the eyes turn round, and in general remain fixed ; the nose shrinks, and the cheeks are drawn backwards.

When the general spasm has continued some minutes at the highest degree of force, with excruciating pains and piercing cries, there comes on a certain state of remission and calmness, but which does not last a quarter of an hour ; and the spasms and pains soon recur with their former violence. In the course of the disease, obstinate watchfulness takes place ; the individual for the most part retains the free use of his intellect and senses : sometimes, however, his ideas seem confused, and his mind is even completely deranged. Respiration is difficult, the voice hoarse, thirst insatiable, with an impossibility of swallowing. The urine, sometimes suppressed, issues with difficulty, or in jets, when the bladder is compressed : constipation is habitual.

In the last place, towards the end, a sort of pruritus,

ritus, or pricking, is experienced in the spine; a sensation analogous to that of a liquid flowing towards the sacrum; a gradual diminution of the symptoms, or a cold, abundant, and universal sweat, convulsions, and death.

The disease, sometimes partial, confines itself to the muscles of the jaw and neck, either anterior, posterior, or lateral. At other times it is universal, and keeps the body in a state of perfect rigidity, extended, or bent backwards, forwards, or towards the sides. The pains are often confined to certain parts, such as the head, the bottom of the mouth, one side of the breast, the epigastrium, the loins, and the limbs. In the last place, salivation, syncope, tremor of the limbs, &c. may take place.

In some cases, the progress of the disease is rapid, and produces death in thirty or thirty-six hours; and, for the most part, before the fourth day. It is when the disease comes on in consequence of wounds (traumatic) that its progress is most rapid. After the fourth day the danger decreases; but there is always reason to apprehend new paroxysms as fatal as the first. The symptoms never disappear suddenly: they decrease gradually, and sometimes require a considerable time before they cease entirely.

Sometimes the progress is slower: the convulsive movements, which are transitory, come on by repeated paroxysms, and at intervals which vary



from one hour to several minutes; the jaws are never forced exactly together; deglutition, though difficult, is always possible; the body is slightly bent forwards; the patient cannot bear to remain in a recumbent posture, and can enjoy no rest but by placing himself in a transverse position, with his belly on the edge of the bed, and his feet on the floor. According to Bajon, this variety, which scarcely ever proves mortal, continues several months, and sometimes four or five. Towards the end there comes on a pretty acute fever, with an abundant sweat, and a cure is then effected. Hippocrates considers fever as salutary when it takes place in this disease. (*Aph.* lvii. *sec.* 4.)

172. In America, the negro children who commonly reside in huts badly sheltered from the inclemency of the weather, and from sudden variations of the temperature, are very subject to this malady. It is much more common on the borders of the sea, and in elevated places, than in districts sheltered by the lofty woods. To secure the children from it, they are kept in close warm apartments, and frequently subjected to dry friction. This disease has become less common in St. Domingo since the female negroes have been made to lie-in in the hospitals. It generally makes its attack in the first nine or ten days after birth, and rarely beyond that period. Some are affected  
almost



almost the moment they come into the world, and die in a very short time.

The child first experiences a difficulty of taking the breast, which it incessantly quits and resumes; it continually emits difficult and plaintive cries, and exhibits a stiffness in the jaw, the neck, and along the spine. The neck remains straight; but the trunk becomes bent either forwards or backwards; the muscles of the limbs are less strongly extended than those of the trunk; the compression of the jaws becomes complete; the tears and cries decrease. Irregular movements in the limbs, the trunk, and jaws, starting of the muscles of the cheeks are then observed, and a slimy salivation takes place. The skin after certain intervals assumes sometimes a red and sometimes a violet tint. This disease always terminates in death, and very often in the course of ten or twelve hours; but, for the most part, towards the second, and sometimes not till the tenth or twelfth day. In general, its progress is slower, according as its attack commences longer after birth.

173. A variety of this disease, characterized by a rigidity of the jaws, difficulty of swallowing, induration of the cutaneous tissue, convexity of the soles of the feet, and an apparent curvature of the limbs, has been observed in the Foundling Hospital at Paris. It appears to have been produced

by the impresson of cold. (*See Soc. Roy. de Méd. Septembre, 1787.*)

The use of opium in strong doses seems to have been attended with striking success in this disease\*, which is distinguished by the name of *Tetanus*.

174. There is one general affection of the nervous system, which manifests itself by alarming symptoms; it is always dangerous, and, for the most part, mortal. It is communicated by the saliva of an animal in a state of madness brought into contact with a part destitute of epidermis. It is in the saliva only that the infectious quality resides; and animals who have died of this disease may be touched with safety.

In general, it is more to be apprehended that infection will take place when the animal has bitten a naked part, than when the wound has been inflicted through the clothes. It is probable, also, that the action of the saliva is stronger or weaker, according to the state of the animal, which may be either melancholy mad, or entirely furious. The greater or less sensibility of the persons bitten, and the particular state in which they are, render them more or less disposed to be affected; the power of imagination, which heightens fear, and the dread of being attacked by so horrid a disease, contribute

\* Opium has been given in very large doses in tetanic affections without producing sleep.

also, in a great degree, to aggravate the symptoms. The period between the time of being bitten and the commencement of the disease is exceedingly various : it generally takes place on the third or the fourth day ; sometimes sooner, and at others not till the end of several months ; some authors even say several years.

The commencement of the madness is always announced by some phænomena in the wounded part ; the scar becomes red, or bluish, and sometimes opens and discharges a reddish ferous matter. If the wound is not cicatrized, its edges are inverted, the flesh swells, assumes a redder colour, and furnishes only reddish and ferous mucus. The sleep is then troubled, and agitated with starting and frightful dreams ; the patient falls into a deep melancholy, from which he cannot be roused ; experiences heaviness and great depression ; heat comes on from time to time, with shivering, which, commencing at the wound, is extended to the whole body, and seems to terminate at the breast and the throat : the pulse, in general, is small, hard, and close.

At the end of three or four days all the symptoms increase : the patient experiences pain in the head, loathing, watchfulness, a general sensation of lassitude, a painful constriction at the breast and throat, which prevents him from swallowing ; respiration is difficult, interrupted by involuntary sobs and deep sighs ;

fighs; convulsions, renewed by the least cause, from time to time take place. The patient, at intervals, loses his reason, becomes furious, does not know his most intimate friends, attempts to bite them, and sometimes even tears himself. Every thing irritates and provokes him; bright colours, the splendour of the light, the least motion, the slightest sound, the agitation of the air, excite his fury. Burnt up by internal heat and ardent thirst, he is afraid to drink; the very idea even of water makes him shudder\*. The face becomes red, and the eyes haggard, fixed, and sparkling; he has an air of ferocity, and at the same time of fear; the voice is hoarse; and spumous saliva flows from his mouth. Retaining sometimes his intellectual faculties, he remains peaceable, immersed in deep melancholy; is sensible of his unhappy state; foresees the return of the paroxysms, and advises his friends to be on their guard. Sometimes he remains in silent stupor; at others emits loud cries and dreadful howlings. Sometimes he acquires

\* The dread of water, and a propensity to bite, are symptoms not peculiar to this disease alone. An aversion to liquids has been observed in some fevers attended with phlegmasia of the throat or stomach, in some cases of hysteric affection, &c. The furor and irresistible propensity to bite and tear, form the character of certain kinds of mania; it is sometimes seen during paroxysms of epilepsy; and these symptoms are not always observed in persons labouring under canine madness; we may even say that they are uncommon.

an extraordinary increase of physical strength; at others is thrown into a state of the utmost timidity, a sort of lethargy or palsy. Trismus, and a spasmodic tension of the muscles of the belly, often take place. Some experience a very painful priapism, accompanied sometimes with ejaculation. At length, after four or five days, the patient is seized with extreme agony; his pulse becomes unequal and intermittent; vomitings, with a universal cold sweat, come on, and he dies in convulsions.

This disease is very rare: all the individuals bitten by mad animals do not experience the symptoms of hydrophobia; and it is probable, that very often after a bite by an animal supposed to be in that state, nervous symptoms, more or less strong, produced by a fervid imagination, a fatal terror, or the laceration of the parts, have taken place. It may be readily conceived also, that the saliva of an animal irritated in a greater or less degree may acquire a certain quality proper for exciting some slight symptoms, which imagination and terror increase, and perhaps render fatal. It is, therefore, of great importance, that a suspected animal should never be killed until the nature of its malady has been accurately ascertained.

The carnivorous mammalia are those only which appear to be susceptible of spontaneous madness: the herbivorous are apt to receive it, but have not  
the



the power of transmitting it. It manifests itself particularly among dogs, during hot summers and very dry winters. This disease is ascribed, in general, to the want of drink, and to extreme fatigue while exposed to scorching heat.

175. The symptoms at first observed in a mad dog are: sadness, dejection, a desire of solitude, startings at intervals; the animal does not bark, but often snarls, and without any known cause; refuses food and drink; his eyes seem dead; he has a wild look, staggers in walking, drags his tail between his legs, appears as if asleep, and obeys with difficulty. At the end of two or three days he does not know his master; abruptly quits his habitation, and wanders about with uncertain steps, his hair erect, and his eye threatening, which is continually in motion, or remains entirely fixed; his head hangs down, his mouth remains open, and his tongue, dependent, is covered with spumous flaver. Other dogs flee on seeing him. Sometimes he shuns water, shudders, and is irritated on seeing it; at other times he swims across it.

In this state he attacks and bites, without distinction, every person or animal that falls in his way; it is then that his bite is exceedingly fatal; but, in general, after thirty or thirty-six hours he dies in convulsions. The body soon passes to a state of putrefaction.

It



It does not appear that canine madness ever took place spontaneously in man\*.

This disease, when once fully characterized, is constantly mortal†.

After death, no traces of alteration that can be exclusively ascribed to the disease are observed in the organs; which seems to prove that it consists in a great perturbation of the nervous system.

If canine madness consists in a deranged movement communicated to the action of the nerves by the poisonous saliva, and if this movement, heightened by the symptoms it produces, increases so far as to annihilate the whole vital force, there is reason to believe, that the most proper mean for opposing the development of the malady is to impress speedily a foreign action on the whole system, and to maintain it for some time‡.

Hence the utility of cauterizing the wound strongly with a hot iron, or caustics, and of maintaining in the part a violent and long-continued irritation. It is necessary also, at the same time, to

\* The reader, however, may see two cases of this kind by Galet Duplessis in the *Mémoires de la Soc. Royale de Médecine*.

† See the single case of Nagent, given also in the *Mémoires de la Soc. Royale de Médecine*.

‡ C. Pinel learned from some person who resided at Lausanne at the time, that Tissot and Haller having caused a man labouring under hydrophobia to be bitten by two vipers, a calmness immediately took place, with a certain degree of insensibility; and the wounds being afterwards dressed, the patient recovered.

port the general energy by powerful stimulants, and in particular to occupy the imagination, in order that the person may entertain no fear of a certain cure.

176. There is another convulsive affection which manifests itself by paroxysms of short duration, sometimes periodical, but, for the most part, irregular. It seems to consist in a sudden interruption of the functions of the intellectual organ, and of the organs of the senses, with a convulsive movement of the muscles.

In many cases the accession of this disease takes place suddenly, without any anterior symptoms: it is frequently announced by a peculiar sensation, like that of some body moving, often from the extremity of a limb, and gradually ascending, without exactly following the course of any principal nerve, as far as the head; after which the paroxysm suddenly comes on. Sometimes the sensation is like that of a cold vapour, or fluid, running along, or of the creeping of an insect; sometimes the sensation can hardly be described. In certain cases, this sensation arises from pressure, from the irritation of a nerve, from a wound, a contusion; but, for the most part, no læsion whatever in the part can be discovered.

This movement may sometimes be interrupted by ligatures, or by fire, occasionally applied. To prevent an attack, and cure the disease radically, extirpation of the part is recommended.

Independently of this vapour, which in certain individuals always precedes, but for a very short time, the paroxysms. they are announced also, in some, at longer or shorter intervals, and sometimes every other day, by nervous symptoms exceedingly various and inconstant: torpor, drowsiness, vertigo, swelling of the eye-lids, watering of the eyes, ringing in the ears, redness of the upper part of the nose, between the eye-brows, turgency of the veins of the forehead, frightful dreams, agitated sleep, violent pains in the head, accelerated pulsation of the temporal arteries, &c.

This disease exhibits numerous varieties, in regard to the violence of the paroxysms, and the number and intensity of the symptoms. Sometimes the paroxysm is a mere stupor, a few minutes of vertigo, a suspension, or at least momentary alteration, of the intellectual functions, with a slight convulsion of some particular part. At other times the face becomes red; the whole body is stiff, and some convulsive movements are observed in the eyes.

For the most part, a sudden and repeated abolition of the mental faculties of sensation and voluntary motion takes place: the patient falls down, and often with a piercing cry. In this case, strong contortions of the limbs, of the head, and of the trunk, are observed, and generally stronger on one side than on the other; distortion of the mouth, face, and eyes; the tongue, which issues from the mouth,  
is

is subject to be severely wounded, and even cut, by the convulsive collision of the jaws; the pulse is small; respiration precipitate and irregular; the penis in a state of erection; and the paroxysm thus passes with constant alternations of calmness and new convulsions.

After a certain period, a matter, commonly viscid and spumous, is rejected from the mouth. In the slightest paroxysms, a few bubbles only appear towards the angle of the lips. Sometimes there is also an involuntary evacuation of urine, of faecal matters, and even of sperm.

The duration of the paroxysm varies from some minutes to about half an hour\*.

Towards the end, the patient remains some moments motionless, with the appearance of profound sleep; at length he speedily recovers, and often gradually, both sensation and muscular strength, without any recollection of the past. The pulse and respiration return to their usual state.

\* I have seen a young woman between the seventh and eighth month of her pregnancy, who after a violent mental affection experienced headache, a sense of suffocation, pain in the epigastrium, and at length a fit of epilepsy, which continued some minutes, and which left her insensible, in a state of torpor and profound sleep. The paroxysm returned in an hour, with the same intensity. This dreadful state of continual torpor and epileptic fits, which recurred at the end of one or more hours, continued thirty-six hours, and was not removed but by the application of twenty-four leeches to the temples.

After

After a first paroxysm takes place, it leaves behind it so great a susceptibility, that the slightest cause very often produces a second; and it at length appears, that there is established a sort of habit which renews the paroxysms without the intervention of any known cause. Many variations occur during the intervals between the paroxysms. Sometimes the periodicity is very regular; but, for the most part, there is no constancy in the returns. It appears, in general, that they follow each other quicker, according as the disease is of longer standing. Some have imagined that they could sometimes discover a certain relation between these returns and the phases of the moon. It is observed also that they take place, in particular, during sleep, or immediately after awaking.

When the paroxysms have recurred for a long time, the disease often terminates by producing a debility of the mental faculties. It gives rise to a greater mobility, a more decided aptitude for all mental affections, joy, anger, &c. It occasions a loss of memory, and a state of stupor, or even madness\*. It alters also the features of the face, enlarges the inferior eye-lids, and the alæ of the nose. After a slight or violent paroxysm there sometimes remain : deafness, blindness, palsy, &c. Sometimes a slight paroxysm is converted into apoplexy.

\* Among two hundred maniacs C. Pinel counted twelve or fifteen epileptics.



This disease is more peculiar to infancy, and even in the first years of life; to youth, to females, and in general to individuals of great nervous irritability, who are as easily animated by hope as depressed by fear; who are moved by the slightest affections; and in whom the impressions of sorrow, anger, or joy, excited by the most trifling causes, subside with the same facility. It attacks plethoric persons in preference to others.

It is often impossible to determine the causes by which this disease is produced. The most frequent, however, are deep-rooted mental affections, violent and unexpected impressions, great sorrow, severe disappointments, astonishing news, the defeat of an army, a strong sense of horror and aversion; but, in particular, a fright in infancy\*. Many individuals have been attacked by this disease merely in consequence of having seen paroxysms of it in others; and this appears to arise from that irresistible propensity to imitation which is exceedingly strong in debilitated persons. It takes place also sometimes after a wound or fracture in the head; a depression of the bones of the cranium; excessive hæmorrhagies, &c.

This disease, especially during the first years of

\* In recapitulating the manifest causes which seem to have produced the first accession among the numerous epileptics of the Hospital de Bicêtre, C. Pinel observed that the last-mentioned cause was the most common.



life, may be produced by so many causes, that it is difficult to ascertain whether children may not be born with it. All those almost who experience frequent paroxysms during their earliest years fall a sacrifice to it before they attain to the age of puberty. When it commences between the age of five and ten, it may sometimes be cured. That which appears about the commencement of puberty (from twelve to thirteen) without any manifest cause, generally ceases when puberty is fully established. Sometimes it is cured by marriage; at others, its symptoms are increased by it.

When it declares itself before the establishment, or during a suppression, of the menstrual flux, it is always cured as soon as the flux becomes regular. Though it comes on after puberty, it does not appear to be incurable. It seldom attacks old persons; and those attacked by it at a younger age are either cured or die before they become old.

On opening the body no organic alterations are in general found, and even when læsion of the viscera\* occurs, it is often difficult to conceive how it could have been the cause of the disease.

The

\* There have been found in the head: caries of the interior lamina of the bones; exostosis; sharp osseous excrescences, of greater or less length, proceeding from different parts of the base of the cranium, and penetrating the encephalic organ; an ulcer in the membranes, the effusion of a fluid. In other parts: an ulcer at the œsophagian orifice of the stomach, phlogosis, vibices, or

The age, sex, and particular constitution which are most susceptible of this disease, and the causes by which it is most frequently produced, seem to indicate that it may be referred to a weakness or too great irritability of the nervous action.

Some examples are quoted, which seem to show, that when a violent impression, stronger than that which produces the disease, and capable of breaking the force of habit which maintains it, is made on the nervous system, a cure is effected\*; but these particular instances are not sufficient to establish any general precept for the treatment of this disease, which has been distinguished by the name of *epilepsy*.

gangrenous spots in the pharynx, the œsophagus, the stomach, the intestinal canal, and in other places; biliary calculi; scirrhoties in the spleen, greater fluidity of the blood, flaccidity of the solids, and a greater tendency of the body to putrefaction when the patient has died of a long continued paroxysm.

\* What Kaaw Boërhaave did at the Hospital for Orphans at Haerlem to check the progress of this disease, which was propagated by imitation, is well known.

## VESANIC AFFECTIONS.

177. THE peculiar affections in which the intellectual functions are essentially deranged are exceedingly numerous and varied. They are never observed, in general, but in persons who make a bad use of the vital powers, and whose intellectual organ is habitually in a greater or less degree of exaltation.

In individuals of a weak constitution, when the function of the intellectual organ is highly exalted in regard to objects of the imagination, when the action of the genitals is strongly excited, when the gastric organs are continually overcharged with too succulent nourishment, highly seasoned, and almost wholly digested, and when the muscular action is annihilated; this concurrence of circumstances, which forms so strong a contrast to the mode of life for which man seems by his organization to have been destined, produces, especially in large cities, a highly varied series of phænomena of disease; but to give a detailed history of them would be tedious and difficult.

A great number of them, however, are comprehended under the two general forms which we are here going to describe.

178. The first often occurs in mature age, that is to say, between thirty and fifty. It is more common among men than among women, is often hereditary, and attacks in preference persons debilitated by irregularities, or by long diseases, those who lead a sedentary life, and such as are addicted to too close study: it is in some measure the disease of men of letters. It arises, for the most part, from a concurrence of causes, more or less multiplied, which exercise a long continued action: excess in the labours of the closet, sudden transition from an active to a sedentary life; the abuse of narcotics; excess in the pleasures of love; sometimes from an acute affection experienced in the epigastrium; a great fright; deep grief; and in women, accidents during pregnancy, or during parturition, &c.

A singular assemblage of varied and extraordinary symptoms are then observed to take place. Those observed in regard to the mental faculties are: unsteadiness of character, fickleness of temper, irascibility, restlessness, sadness, timidity, and languor. The individual pays minute attention to the state of his health; every change of sensation makes him apprehend danger, and even death; he becomes unfit for labour; a derangement of memory and transient delirium take place; his sleep is disturbed; he experiences pains in the head, vertigo, confusion of sight, ringing in the ears, dullness of hearing,

hearing, an irregular sensation of ardor in the face, sudden alternations of heat and of cold sweats. These symptoms become exasperated at irregular periods, and sometimes in a constant manner after meals: in general, the patient is much affected by every change in the state of the atmosphere.

The gastric system, in particular, exhibits varied symptoms of derangement: such as loathing, deprivation of taste, nausea; irregular appetite, sometimes none, and at others a voracious one; tension and heavy pain in the stomach, especially after meals; bad digestion, frequent vomiting, belching up of burning and highly acid matters, hiccup, shooting pains in the abdomen, flatulencies, borborygmus, constipation or diarrhœa.

Sometimes swelling or even a very hard tumour is felt towards the hypochondria; the patient experiences a sort of constriction at the breast, oppression, palpitation, irregular throbbing in some parts of the abdomen.

These affections, which often continue for several years, occasion a slow and gradual consumption, that in the end always becomes mortal.

Very often, on opening the body, no organic alteration is observed. A scirrhus, however, is sometimes found in the colon, an enormous swelling of the spleen, ulcers in the pancreas, varices in the meseraic veins; and it is probable that these derangements have at first often been the conse-



quence of a nervous affection of the organs of digestion, and that they have afterwards become the cause of a part of the consecutive accidents. The aggregate of these symptoms is generally distinguished by the name of *hypochondriasis*.

179. The second form is met with, for the most part, among females, rarely among the other sex, and chiefly among young women of an ardent constitution, who have a strong propensity to venereal pleasure; among women of all ages who live in a state of voluntary or forced continence; among young widows, who, suddenly deprived of the enjoyments to which they were in some measure accustomed, abandon themselves to high living, to indolence, to lascivious ideas, and to the reading of books calculated to excite them; among those whose menstruation is difficult; in a word, among all persons who make a bad use of their intellectual, digestive, muscular and generative organs.

With these dispositions, the sight of a handsome young man on the stage, or in a cheerful company, a disappointment, a fit of passion, peculiar odours and flavours, accidents during pregnancy, and very often causes which cannot be discovered, may produce the following series of symptoms, which sometimes come on gradually, but for the most part by paroxysms.

The



The individual first experiences drowfiness, agitated sleep, intervals of sadness, astonishment, and stupidity, often accompanied with the effusion of tears, or incoercible laughter, for whole hours. The organs of the senses are in such a state of debility and irritation, that they are painfully affected by a strong light, a shrill sound, strong odours and flavours, sudden touching, and every unexpected movement. The limbs remain in a state of torpor. Sometimes a heavy pain takes place in the forehead, in the temples, and the eyes, with a confusion of sight, and, at intervals, aphonia. The patient experiences, in the left side of the abdomen, or towards the hypogastrium, a pain and tumefaction: a sensation like that of a globular body moving in various directions, proceeds towards the stomach, and gradually ascends thence to the larynx. *In all these cases a spasmodic constriction is felt in the throat, with a sort of suffocation.* A spasmodic affection of the intestines is observed, with borborygmi exceedingly noisy, and very irregular agitations. Sometimes tension and tightness of the belly take place, accompanied with a constriction of the anus; the urine is often abundant and limpid; respiration, short and precipitate, is performed by starts; at other times it is suspended; and in this case the pulse becomes insensible. Alternations of redness and paleness are observed in the face; in some cases the visage and neck are red and

and swelled, with a strong pulsation of the arteries. At length the trunk becomes stiff, is twisted round in different directions; the limbs experience a spasmodic contraction; a cold sweat is diffused over the whole body, and the patient remains in a state of apparent death, which may continue forty-eight hours, rarely more. Sometimes all these accidents terminate in real death.

On the decline of the paroxysm a gradual return of the natural heat, and of the use of the senses, is effected; the strength is progressively restored, and the spasmodic symptoms at length cease. Repeated sobs and sighs take place, with flatulent eructations; a relaxation of the genital parts, and a discharge of mucous matter. The person awakes as from a profound sleep, for the most part with a pain in the head, and general languor, and a remembrance or no recollection of what occurred during the paroxysm.

The intensity and nature of the symptoms, the alternation of some of them with each other, their greater or less exacerbation, their longer or shorter duration, produce all the varieties of this disease; which may be more easily conceived than described.

Very often, on opening the bodies, no organic derangements of the abdomen are observed: sometimes, however, an alteration is found in some of the viscera; but in this case they appear to be rather

ther the effect of the long series of nervous affections which constituted the paroxysms, than the primitive cause of them\*. It is, however, certain that these derangements, when they exist, must afterwards render more complex and increase the gravity of the symptoms of this disease, which has been distinguished by the name of *hysterics*.

180. Medicine has very little power over this disease or the preceding; or can only produce some slight remission in the paroxysms. As these affections evidently arise from a bad use of the function of the intellectual, muscular, digestive, and generating organs, they cannot cease till these functions are employed in the proper manner: hence occupations agreeable either in point of taste or of interest, travelling, exercise suited to the strength, wholesome nourishment not too succulent, and which may afford occupation to the stomach, moderate use of venereal pleasures, are the only means of restoring health.

\* Vesalius often found the ovaria larger than a tennis ball, and filled with a yellow liquid highly fetid; Riolan found an ovary indurated, and larger than the fist; Binniger observed a steatomatous state of the ovaria and the uterine tubes containing a white, thick, and almost solid humour; Diemerbroeck, a certain increase of size in the uterus, and a yellowish humour in its cavity; Mager found the uterus voluminous, entirely ossified, and filled with a whitish, purulent, and somewhat thick liquid, &c.

181. The

181. The intellectual organ is sometimes deranged in consequence of the too great action exercised on it by the uterus, or of the reciprocal action of these two organs, which mutually exalt each other.

In young women of premature passions, who are deeply in love, and whose inclinations have been thwarted by insurmountable obstacles; in debauched females, especially when suddenly torn from their antient habits by forced seclusion; in ardent females united to cool husbands insensible to the enjoyments of love, or whose weak constitution commands temperance; in young widows suddenly deprived of strong and vigorous husbands, in their intercourse with whom they had acquired the habit and need of pleasure, and the remembrance of which occasions bitter regret; when these first dispositions are much increased by sorrow and disappointment, by reading lascivious romances or poetry, or looking at lascivious pictures, with which their imaginations are continually heated; by the use of succulent, delicate food, generous wines, strong liquors, idleness, and particularly a habit of solitary pleasures, a series of very extraordinary symptoms sometimes takes place.

There is first observed a singular inclination to direct the conversation to one favourite subject; great languor and ennui when it turns on any thing else; a great readiness to listen to flattery; an  
aversion

aversion to all occupations, even of the easiest kind. These phænomena are soon succeeded by dejection, uneasiness, a love of repose, solitude, and silence. All the thoughts are entirely confined to obscene objects ; appetite and sleep are both lost. The individual becomes subject to inordinate desires, of the turpitude of which she is fully sensible ; she makes efforts to return to a state of reason, or at least to conceal from others her condition ; she even hopes to be able to conceal it from the person who is the cause of it.

Soon after she becomes entirely abandoned to lascivious thoughts, which she despairs of being able to resist ; a last attack is made on modesty, which is now compelled to yield ; the strength is exhausted ; deep melancholy comes on, and effrontery assumes the place of decency. The least flattery is received with an impassioned tone of voice and gestures ; she is lavish of her caresses, prayers, solicitations, and even threats, to induce the first person she meets to gratify her desires ; and if he resists, she insults him with the most calumnious reproaches, and bestows on him every opprobrious name that anger and revenge can suggest.

At length a complete alienation of the mental faculties is announced by disgusting obscenity, cries, transports of passion, lascivious gestures, an affectation of nudity ; all males are solicited, urged, and followed with a blind fury, and beaten or torn if they resist.



resist. The patient experiences continual watchfulness, an universal burning heat, without fever or thirst; insensibility to the most severe cold.

In all these periods, but particularly the third, there is often experienced a very distressing itching towards the vulvo-uterine conduit and the uterus. These parts, which are sometimes inflamed, excrete a thick, viscid, sanious liquor, and the clitoris becomes lengthened or tumid. In this case, on opening the body, there are found an ulcer in the uterus, swelling of the ovaria, &c.

This peculiar alienation, known under the name of the *nymphomania*, belongs, in a great measure, to moral medicine.

182. Men are sometimes subject to a disease which has some resemblance to the nymphomania. It announces itself by an insatiable desire for venereal pleasures, while erection is neither weakened nor diminished by enjoyment. A general spasm or tension prevails in the groin, with pain in the genitals, an itching or titillation in the sides and arms; the face is red, and covered with sweat; the patient bends his body, squeezes his belly with his hands, and falls into a state of sadness and dejection. The progress of the disease is announced by obscene discourse, indecent actions, lascivious motions, and an impossibility of restraining them. The patient, much altered, has a horror of food,

devours it with avidity; he vomits up a viscid matter, and foams at the mouth, like a stag in rutting-time.

If the termination becomes fatal, a painful tension is observed in the abdomen; a stiffness or contraction of the limbs; bodily motion is difficult; the pulse is small, weak, and irregular; and the disease, become exceedingly rapid, may produce death in seven days. A cure is sometimes produced after abundant mucous or bilious stools, and vomiting of the same nature.

This disease, called *satyriasis*, is more common in warm countries, at the period of adolescence, and among individuals who have a strong propensity to venereal pleasures. Aretæus, from whom this description is borrowed, appears to have had some opportunities of seeing this affection. He lived in a warm country, and among the Greeks, a people who seem to have carried to the utmost extent every thing that could inflame the imagination, and raise it to the highest degree of exaltation. In our climates this disease is uncommon.

183. The intellectual function, without appearing to be totally deranged, often exhibits evident characters of exaltation, weakness, and very great mobility, which constitutes a particular state, which we are now going to describe.

During the first period it announces itself by habitual

bitual sadness, irascibility, and watchfulness. The patient afterwards becomes subject to continual fears and sudden terror; his sleep is disturbed by frightful dreams. He is rendered uneasy by the least trifle; falls into violent fits of passion, followed by speedy repentance; exhibits traits of sordid avarice, and afterwards of the most lavish prodigality; a taciturnity, interrupted sometimes by bursts of convulsive laughter; and, in a word, every thing that characterizes the utmost fickleness and inconstancy.

During the further progress of the disease, he entertains continual suspicion and fear of poison; his terror is every moment renewed, with constant hesitation, aversion to mankind, abjection, love of solitude, whimsical, fantastical, and superstitious ideas; ridiculous complaints, wild flights of the imagination; the delirium is fixed to one object, which the mind pursues with the most ardent perseverance; and this delirium carries to the utmost degree of exaltation the affections which it produces. Sometimes the patient shows a determined disgust to existence, and an irresistible propensity to suicide. This state is often the effect of an exaggerated idea of the misfortunes of life, of disappointment, and sorrow: at other times it seems to be the result of too advantageous a situation in point of fortune, which places the individual in a state where he has nothing further to  
hope,

hope, or to fear ; which presents no obstacle to be surmounted, and affords no field for new enjoyments.

Independently of these symptoms, or of others equally singular, some individuals exhibit an exalted sensibility, sometimes perverted, and irregular returns of spasms or convulsions, with an habitual delirium more or less striking. These paroxysms, suspended sometimes by other diseases, re-appear during convalescence ; they terminate sometimes in mortal spasms, and at others in general consumption.

These symptoms of alteration chiefly affect persons who have a peculiar constitution of body and mind : such as a meagre and withered appearance ; pale, leaden, or yellowish-colour ; harsh and forbidding gravity ; character unequal and capricious ; squinting look, studied reserve, serious and thoughtful mien ; air of timidity and circumspection, difficult temper ; good appetite, but attenuation by watchfulness ; sometimes abstinence through the fear of poison, withering and drying of the body, premature old age ; moroseness strengthened by the progress of years.

This state is remarked, for the most part, in the age of virility ; it commonly begins in the summer and autumn, and ends in the spring. It is produced by a concurrence of causes highly various,

as : excessive study, religious fear, violent or unfortunate love, profound grief, reverse of fortune, the abuse of intoxicating narcotics, solitude, the interruption of an active life, idleness, luxury, effeminacy, and satiety of all the pleasures of life.

This state does not render confinement necessary, or produce a profound and acute alteration, which soon brings on death, or slowly terminates in real consumption. This affection is often cured by a reverse or an amelioration of fortune, a powerful distraction, and by every thing that can excite a lively interest beyond the ordinary habits.

This disease, the aggregate of the symptoms of which constitutes *melancholy*, shows a great relation to that which remains to be described, and with which it is often confounded.

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184. In a great number of alterations of which the intellectual functions are susceptible, the most striking symptoms of derangement come on instantaneously by fits : their return, for the most part, is irregular, and sometimes periodical.

*Mania*, whether during the paroxysms or during the state of calmness, presents itself under different forms, which depend on the mode of alteration in the function of the intellectual organ. In general, the violent paroxysms are never of long duration ; they always terminate, at the end  
of



of a longer or shorter period, by a sort of calm, or milder mania : others exhibit a constant state of insanity, or absolute idiotism.

On the approach of a paroxysm of mania, the first effect which results from the derangement of the cerebral organ manifests itself, in particular, towards the abdominal region. A constriction is observed of the epigastrium ; loathing of food, obstinate costiveness, sensation of burning heat in the intestines, then in the breast, and at length in the face, with a desire for cooling liquors.

Soon after, the individual exhibits extraordinary gestures, with singular looks and movements. Sometimes there is an elevation of the head, with the eyes fixed on the heavens ; the lunatic speaks with a low voice, walks about, suddenly stops, with an air of admiration, or of profound recollection. Sometimes he indulges in excess of mirth, manifested by immoderate bursts of laughter ; at other times he falls into profound silence, accompanied with an effusion of tears, great sadness, and extreme anguish. Very often he exhibits sudden alternations of immoderate joy and of the deepest grief. In certain individuals, the eyes almost of a sudden become fiery and sparkling, and the cheeks coloured ; which announces the necessity of speedy confinement. In others, a sudden and incoherent flow of words is observed, with frequent fits of laughter, torrents of tears, and soon after fury, and

an irresistible propensity to violent and sanguinary actions. In almost all maniacs a sort of transient effervescence, and a real exacerbation, take place on the approach of storms, or in consequence of a very warm temperature of the atmosphere. They are then seen to run along with precipitate steps, declaiming without order or connection; falling into a violent rage, without any cause, or on the slightest provocation, emitting loud and confused cries.

The paroxysms of religious mania are often preceded by ecstatic visions. Those of mania from love are preceded sometimes by enchanting reveries, and a supposed appearance of the beloved object.

Mania, in general, manifests itself under the appearance of a continued transport of anger more or less impetuous; and it is much better characterized by these emotions of an irascible mind, than by confused or whimsical ideas.

Some maniacs show a wonderful constancy and facility in enduring the most rigorous and long continued cold; some even experience an evident enjoyment by the application of ice to the epigastrium; but in many cases their sensibility for cold is exceedingly great, and instances of the hands and feet of some of them being frozen have at times occurred. Some remain obstinately awake. In most of them a nervous excitement, marked by a considerable  
augmen-

augmentation of muscular force, with a strong conviction that nothing can resist them; takes place; they then display the utmost intrepidity, and give full scope to the most extravagant caprices.

On many occasions they refuse all nourishment for four, five, and even for fifteen days, provided they are amply supplied with drink. On the other hand, they often experience a most singular voracity, and speedily become faint when deprived of the usual quantity of food.

Warm seasons have a striking influence on the return of the paroxysms, the duration of which is pretty generally confined within a certain period of from three to five months. They commence in that which follows the summer solstice, continue, with more or less violence, during the heats, and terminate towards the end of autumn. In some maniacs, however, the paroxysms renewed at the end of autumn are continued throughout the winter, with remissions or exacerbations according to the degrees of cold. Some cases have occurred also, where the paroxysms taking place in summer have been renewed on the commencement of the cold weather. It may be readily conceived that the following causes must contribute to the renewal of the paroxysms: transports of passion excited; the presence of objects calculated to revive in the mind

the original cause of the madness ; the abuse of intoxicating liquors, forced abstinence from food, &c.

But some paroxysms are renewed at fixed periods, without seeming to be determined by any known causes\*.

Mania presents itself under different forms, according to the nature and intensity of the derangement of the intellectual functions. These different forms may be arranged under the following four principal heads :

1st. *Weakness or exaltation of the intellectual faculties.* The individual, in this case, displays great levity, stupid absence, impossibility of keeping the mind fixed a few minutes on the same object ; singular inconsistency and giddiness ; continual mobility, attention to childish occupations, weakness of memory, sudden flights, loquacity or taciturnity, a rapid series of incoherent ideas, premature dottage ; and sometimes incoercible transports of passion, arising from the nature of the organiza-

\* At the Bicêtre a maniac every year experienced an attack which lasted three months, and which terminated towards the middle of summer. Another was seized with a paroxysm every two days in three, being always one day in a state of tranquillity. A third was in a state of the most furious madness for fifteen days, and then remained in perfect calmness eleven months and a half. Three others continued eighteen months without any confusion of ideas, or wildness of imagination ; but for six months after that period they were raving mad.

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tion, or a vicious education. During the paroxysms there are frequently observed an exaltation of the intellectual faculties, great fertility of imagination, a sort of inspiration and enthusiasm for the greatest virtues, public and private.

2d. *Partial or instantaneous alteration of the intellectual faculties.* In this case the imagination is exalted in an extravagant manner, or strongly impressed with some erroneous idea; the senses seem to receive the impression of objects which do not exist\*: in other respects the judgement is sound; and the ideas coherent, even in regard to the erroneous object. Childish fear is often observed, with great timidity; and the utmost mistrust, which induces the individual to refuse every kind of food, and to remain awake; also fanaticism, and fondness for the marvellous. During the paroxysms, the deranged movement and confused agitation of the brain excite a propensity to destructive and even to sanguinary actions. Some individuals then imagine that they have an irresistible desire to commit murder, confirm themselves in this idea, and deplore their condition†.

3d. *Com-*

\* Frequent instances of this kind may be found in mystic visionaries, and persons who imagine they every where see poison, monsters, serpents, &c.; who think their legs are of wax, or their posteriors of glass; who believe themselves converted into animals, prophets, deities, &c.

† C. Pinel, in his ingenious work on madness, from which we



9d. *Complete alteration of the intellectual faculties.*

In this case, the individual betrays a want of judgment in regard to all objects, accompanied with aberration of memory. This state affects different forms: the mania often seems to consist in, a strong nervous excitement, a turbulent restlessness which admits of no repose; agitation, cries, sparkling appearance of the eyes, obstinate watchfulness, superiority of physical strength, ardour for venereal pleasure; a blind tendency to derange, break, tear, and destroy every thing, and even to commit sanguinary actions; delirium of happiness and joy, illusions, extravagant flights of pride, in those who suppose themselves to be generals, prophets, and deities; fantastic visions. The maniac imagines

have taken the materials of what has been here said on this subject, is of opinion *that the functions of the will are distinct from those of the understanding*; which is contrary to the opinion generally entertained respecting the analysis of the intellectual functions. He gives the history of a lunatic whose periodical madness was announced by the most sanguinary fury, which the individual said he was not able to restrain. During his lucid intervals he deplored his miserable state; continually spoke of it, and became more and more confirmed in the idea that he had an irresistible propensity to murder: but this state was, no doubt, the effect of a deranged intellect, and it is not more extraordinary to see a maniac with a persuasion that he has an irresistible propensity to sanguinary actions, than to see another impressed with a belief that he is a prophet or a king. In our opinion, this kind of madness may be assigned also to the province of moral medicine.

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he every where sees dæmons, serpents, poison ; has a rapid succession of ideas which seem to arise from the strong excitement of the brain, without any relation to the impressions made on the senses ; with exuberance of words ; tiresome loquacity ; continual succession of incoherent ideas ; tumultuous concurrence of different affections and sensations, of joy, sadness and anger.

4th. *Annihilation of the mental faculties.* In this case are observed : an inanimate figure, air of idiotism, habitual stupor, insuperable inactivity, automatic motions ; foolish and silly laughter, continual silence, or a few inarticulated sounds ; life merely animal ; no memory ; the ideas and language confined to objects calculated to satisfy the common necessities of life.

In maniacs who have been exposed to violent and long continued paroxysms, there are observed, at the period when these paroxysms terminate (for the most part towards the end of autumn), great weakness, a sensation of general lassitude, a faintness which often produces syncope, great confusion of ideas ; sometimes a real state of stupor, and almost of insensibility, with moroseness of temper and deep melancholy. The unfortunate individual remains in bed, stretched out motionless, with the features altered, and a weak depressed pulse. In this state of atonia he runs the risk of perishing, especially

especially if the cold be severe, and unless the vital heat be maintained by cordials and the accumulation of bed-clothes.

Observation induces us to class among those subject to mania, persons who show an ardent imagination and great sensibility, energetic passions, and the most estimable moral virtues.. This affection takes place equally at all ages. It is much more frequent among women than among men, and scarcely ever is observed among those who cultivate the exact sciences.

According to information acquired in regard to the former state of maniacs, it appears that we may consider as the most common causes of this disease : a violent and unfortunate passion, inordinate ambition, reverses of fortune, fanatical devotion, the delirium of ardent patriotism. Aretæus includes also too liberal sacrifices to Bacchus and Venus; and among the women, forced abstinence from the enjoyments of love, &c.

But, in general, there exists no constant relation between the type, the specific character, or the intensity of the mania, and the cause or nature of the object which has primitively given rise to it. These variations seem to depend more on the degree of sensibility of the individual, and on numerous fortuitous causes which affect his intellectual organ, exalted or weakened. In general,

ral, a more irascible disposition, and transports which often border on madness, are observed among those vigorous men, whom Cabanis describes with so much truth and energy in the following sketch\*:—"Bolder and more striking looks, sparkling eyes, a dry and often yellow visage, jet-black hair, sometimes frizzled; strong limbs, but without corpulency; great muscular strength though in appearance slender; a meagre body, and projecting bones; strong, hard pulse. These men," says the author, "are continually hurried away by the torrent of their imagination and passions. They wish to carry every thing by force, violence, and impetuosity." On the other hand, more moderation is observed in the mania of persons with chestnut-coloured hair, and of a mild and moderate character. Among such persons, in particular, it is found under the appearance of a calm and peaceful reverie, which often terminates in idiotism, or a sort of imbecility often incurable.

Mania does not seem to arise from any known derangement of the cerebral organ. The bodies of maniacs, when opened, rarely exhibit any traces of very evident alteration in the brain. This disease seems rather to consist in a disorderly movement, a weakness or too great mobility of the nervous action; a real alteration in the intellectual

\* Mémoires de l'Institut, an. vi.

functions;



functions; and it is proper to see, with Stahl, since imitated by Pinel, in the development and progress of the paroxysms, all the phænomena of salutary reaction. We indeed observe: abdominal spasms, coloration of the face, accelerated circulation, exalted energy of the mental and bodily powers; the excitement of blind impetuosity, incoercible agitation. The understanding is hurried away by the force of these combined movements; and after a certain duration, the extent of which is variable, there come on: a diminution of these phænomena, a depression of all the faculties of the individual, a progressive return to reason; and the cure, in general, is the more probable as the paroxysm has been more violent. It seems to be proved by observation, that of all the varieties of mania the most obstinate are those which exhibit pure idiotism, the imbecility and stupidity of the *Cretins*; that we must place in the next class continued mania, which does not present any striking exacerbation: in a word, that the hope of cure is at the highest degree in periodical mania, and particularly in individuals from the age of eighteen to that of twenty-five, who possess the greatest force of nervous reaction. Instances of cure at an advanced age rarely occur; as if a shock so violent were above the powers of nature after the period of the greatest vigour. Sometimes the paroxysms



oxyfins gradually increase, and at length become mortal.

185. Will it still be the practice to employ indiscriminately bleeding, bathing, camphor, opium, &c. in the treatment of mania, notwithstanding the bad effects which they are daily known to produce?

“Madmen must not be considered as entirely deprived of reason, and as inaccessible to every motive of hope or fear; to every sentiment of honour. They must first be subdued, and then encouraged.” *Bibliothèque Britannique*, vol. viii.

To console lunatics, to speak to them with kindness, to avoid by evasive answers a refusal which might irritate them; to overcome their obstinacy by inflexible firmness, without any act of violence; to guard against excessive complacency as well as ill-timed contradiction; to inspire them with salutary fear, but always connected with a sentiment of esteem; to remove every circumstance that might recall to their minds the primitive cause of their madness, and which consequently might produce an exacerbation, or perpetuate its duration: such, perhaps, is the sum of the general means afforded by what may be called moral regimen. But the first of all, no doubt, is to remove the lunatic from his usual residence, from the bosom of his family, where

where he might be constantly surrounded by objects connected with all his habits, and from persons whose presence might continually remind him of his misfortunes, of the causes of his unhappiness, &c. none of whom could second the exertions of the physician, and much less acquire over the maniac, in an effectual manner, that absolute empire which commands obedience. It is, therefore, indispensably necessary, that such persons should be conveyed to public establishments, where the best possible means are provided for putting in practice this mode of moral treatment : such as very spacious, solitary, and well secured accommodations, where the maniacs when attacked by the paroxysms may be separated, and be thus prevented from irritating each other, or from disturbing those who are in a state of convalescence ; and where they may be carefully watched under the inspection of men who have acquired by practice the proper methods of restraining lunatics without violence, and without danger to themselves.

But when it is known that most of the public hospitals for the reception of lunatics are established on the same plan, and adopt the general method of subjecting them to a uniform mode of treatment, by employing bleeding, the cold bath, and pretended calmers ; and that others are provided

vided for receiving them afterwards as incurable, and for locking them up like so many savage animals, it may readily be conceived how far such establishments fall short of the perfection to which they might be carried in consequence of the enlightened state of the present period.

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RECAPITULATION  
OF  
THE HISTORY OF DISEASES,  
WITH  
VARIOUS REFLECTIONS.

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186. A MINUTE history of the numerous diseases to which man in a state of society is subject, and a knowledge of the causes by which they are produced, evidently prove that the whole of them almost have had their origin among individuals crowded together; and that they are the result of local influence, of the manner in which people are lodged, clothed, and fed, and of the varied employment of the different functions.

The human race are not subject to more diseases than the other animals; and every well-organized person who resides in a salubrious country, who enjoys a sufficiency of wholesome nourishment, who makes a proper use of his functions, and who is secured from every accident, experiences no disease, and dies of old age.

Man in the savage and hunter state exhibits the type of the most energetic organization. Being continually employed in exercises which call forth

his strength and agility, and fed on the flesh of the animals he has caught, he finds himself under the two circumstances most favourable for acquiring an athletic constitution.

Though man, in consequence of the general constitution of his digestive system, is polyphagous, animal food is that most agreeable to him, and the kind which he naturally prefers. The carnivorous savage acquires those habits of cruelty which are the necessary result of his mode of life, and which are found among all animals that, like him, feed on the produce of the chase.

Ichthyophagi, such as are the greater part of the Finns, exhibit an organization much less robust; they employ patience and dexterity, rather than strength and courage, to catch their prey, and their food is less nourishing and less salubrious.

Nomades, employed alone in guarding the herds and flocks which supply them with a milk diet, such as the small number of Tartars, who abstain from flesh, do not possess that strength and dexterity acquired by the exercise of hunting; and in the wars carried on against them by the hunter hordes, they always show a very great inferiority; in a word, considering the exercise they take, milk to them is a sufficient and proper nourishment.

In the last place, those who live only on vegetables, like the Indians, exhibit, at the same degree



of civilization, weaker constitutions and milder manners.

In these different states of strength and energy, if men are not crowded together in too great confusion; if they reside in temperate climates, habitually dry and free from marshy exhalations, they all enjoy perfect health, and arrive almost uniformly at death by old age.

But, in proportion as men unite in society, different diseases, to which they afterwards remain subject, are developed amongst them.

187. Scurvy is one of the affections first observed among riverian people, or those who inhabit countries partly covered by water.

The continued action of cold moisture debilitates their nervous strength, and produces in them a sort of death at the surface of their bodies; the skin grows pale, and is covered with livid spots; exudations take place in the cellular tissue; it becomes choked up, or decays; the gums swell, and are ulcerated; they experience pains more or less acute, their limbs often shrink, and they perish in a sort of consumption.

Men are the less capable of resisting the influence of this humidity the more they are weakened by rest or fatigue, by the want of nourishment, by the bad quality of their food, and by all those causes which tend to debilitate.

That

That weak and debilitated constitution which produces scurvy is afterwards transfitted, in part, by generation.

The fatal influence of continual humidity in a cold marshy country may, in a great measure, be corrected by human industry : hence, to dig canals for the purpose of giving motion to the stagnant waters ; to provide elevated habitations, better clothing, sound nourishment, alcoholized beverages ; to pay attention to cleanliness, and use proper exercise, are the best means for preventing, almost entirely, scorbutic affection in the dampest countries, as may be seen in Holland. It is by employing a part of these means that navigators are enabled to prevent the scurvy on board ship during long voyages.

Warm-blooded animals, and even a great number of plants, experience affections analogous to the scurvy, by the continued action of excessive moisture.

188. In the infancy of society, when men, as we may say, are wanderers on the earth, without proper habitations ; continually exposed to the intemperance of the seasons in different climates ; forced to an incessant activity to insure their safety and to provide for their wants, the organization becomes habituated to the impression of heat and cold, dryness and moisture.

The skin, by its continual exposure to the air,

and by successive friction against different bodies, becomes indurated. The muscular system, by varied and extensive exercise, acquires great force; and the lungs are habituated to inhale atmospheric air at different degrees of heat and moisture. The stomach receives coarse aliments, which require great labour to be digested; and it can bear without difficulty either an excess of food or long fasting.

In a word, a being who is thus continually stimulated by abrupt and frequent changes of his condition, and who is not subjected to the influence of any habit, acquires a considerable force of organization. In this state blows, falls, privation of every kind, heat, cold, and humidity, though carried to a very great degree, produce only very slight indispositions. Every part possesses a strong power of reaction; and all these organs, so fine and so delicate, which seem so easily deranged, form by their pliability and action a whole capable of resisting the most powerful causes of destruction.

189. On the other hand, at a degree of civilization pretty far advanced, when men united in cities begin to have well built habitations which continually shelter them from the injuries of the air; when their skin is secured by good clothing from the contact of exterior bodies, and from the impression of cold and dampness; when habit or domestic

domestic occupations withdraw them from the influence of atmospheric variations, their parts acquire a great susceptibility for being affected by every abrupt change. Their organization does not possess that power of reaction which opposes the first causes of derangement, or which speedily removes any interruption that may have taken place in the functions. Each organ is easily thrown into disorder, and the derangement which continues, for want of the strength necessary to repair it, soon becomes itself the cause of a new affection; and hence we often see a succession of different derangements produced by each other, all arising from one slight cause, which nature had not power to overcome, and which art is not able to prevent.

190. The violent and unusual impression of any cause whatever on organs easily irritated, produces numerous *phlegmasiæ*.

The *phlegmasia* of any organ always consists in a change in the state of the function peculiar to it, with an alteration in its intimate structure.

It may be readily conceived that every part of the body is susceptible of this mode of affection; that each must exhibit it in a manner peculiar to itself; and that the same organ may present a great number of varieties in this order of diseases.

The greatest and most important difference in the *phlegmasiæ* arises from their progress. Some

proceed in a rapid manner, soon produce a general derangement, and either terminate at the end of a short and limited period, or are changed into chronic affections. Others are exceedingly slow in their progress, and in the course of time often produce very great alterations, without having been observed at their commencement. It may be easily conceived, that between these two extremes there must be a great many intermediate shades.

Phlegmasiæ vary in the different organs, and in the analogous parts are the same; so that the different anatomical systems of organs furnish the natural divisions of this class of diseases.

It may, indeed, be readily conceived that a mucous membrane, for example, must be affected in an analogous manner, whether it serves to form part of the ærian, alimentary, or genito-urinary passages. The case will be the same in regard to the serous membranes, the cellular tissue, the bones, the muscles, the skin, &c.

191. We shall here take a cursory view of the different kinds of phlegmasiæ; beginning with those which appear to be simplest.

When the skin has been divided or cut, the edges of the wound tumefy, and become red and painful; the heat and circulation in the part are increased. These first phænomena result from the  
laceration



laceration of the nerves. Soon after the edges of the wound secrete a viscous fluid, which is effused between the lips of it, and causes them to adhere.

When the division is very small, and does not reach beyond the skin, the union may be effected in a few hours. On the other hand, when large and deep a much longer time is required; but, in all cases, it is sooner effected according as the union of the edges has been more exact, and as the individual enjoys a better state of health.

The edges of the wound may unite, even though they have sustained a violent contusion; though they have remained separate for several days, and though they retain between them coagulated blood: so that it is always proper to try to effect an union by the means which the art of surgery indicates in such cases, as long as the part is not affected by a general phlegmasia.

Almost all those topics which are employed to favour the union of wounds are at least useless.

When it has not been possible to unite a solution, the edges secrete a viscous fluid; cicatrization takes place slowly, and in the manner of wounds with a loss of substance. In the latter, as in cases of simple division, the phænomena arising from læsion of the nerves, and their exposure to the air, first take place; the secretion then becomes more abundant, and the wound gradu-

ally cicatrizes from the circumference to the centre, by the formation of a new epidermis.

When nothing but the epidermis has been removed, as is the case in slight burns, cicatrization is spontaneously effected in every point at the same time.

The method most proper for favouring the cicatrization of a wound is to apply nothing to it. This method, which is certainly the simplest, is perhaps the only one which has never been thought of. I have obtained very rapid cicatrization by covering ulcers with a pierced dressing. By these means they are defended from the contact of every body, and from the impresson of the atmosphere, while the air is allowed to circulate at their surface: the air carries off the humidity disengaged, and which by remaining opposes cicatrization.

The *pus*, called *laudable*, which is formed in all deep wounds, is not produced at the surface of those which are left exposed to the air. The formation of this pus is promoted and maintained by the application of the foreign body which covers it. Those which remain exposed to the air suffer to exude from them a small quantity of viscid, ferrous matter, which becomes dry, and below which the epidermis is formed.

There are a great number of cases in which it is found necessary to cover wounds. The laws of physiology, like those of philosophy, can rarely be  
applied

applied in their whole extent; but whatever method be adopted, these laws must always be employed as a guide.

Thus, in every case where dressing is requisite, it must never be forgotten that the most beneficial course, when possible to be followed, is to apply nothing to the wound; and therefore the least irritating substances ought to be used, those best calculated to absorb the pus which is formed must be chosen, and care should be taken that they do not adhere to the edges where cicatrization is taking place.

No topics have the property of hastening, in a direct manner, the cicatrization of wounds, and the best vulneraries are those which do the least hurt. However, when the wounded part is in a state of weakness which retards the process of cicatrization, all stimulants may become useful vulneraries.

Wounds cicatrize the speedier the fresher they are, and the sounder the constitution of the individual. It will therefore be proper, in all cases, to endeavour to bring them back to the recent state, and to restore strength to the organization. The appearance of a wound may always serve to indicate the state of the individual's health.

When an ulcer has been of long standing, either in consequence of the individual's bad health, of the peculiar weakness of the wounded part, or of any local irritation whatever, nothing is secreted

but sanious and fetid pus ; its edges become hard and callous, the adjacent part assumes a violet colour, and at length loses its former sensibility. In this state of things, it will sometimes be proper to make a new wound in the old one, in order to produce cicatrization.

192. Phlegmasia of the cellular tissue exhibits, in the formation of phlegmon (tumour), a series of phænomena the progress of which may be easily followed.

When a thorn is introduced beneath the skin, the individual immediately experiences an acute pain, which gradually ceases ; but some days after there comes on around the prick a slight redness, with swelling and heat, and the pain is renewed. Sometimes, also, a general derangement of a slight and transient nature takes place.

If this new mode of action continue, the swelling increases and spreads ; a slight tumefaction of the neighbouring lymphatic glands takes place : a small tumour then arises, which becomes white, breaks in the most prominent part, and affords an issue to the pus, which carries with it the thorn.

The presence of the thorn was not necessary to give rise to all this series of phænomena ; the prick alone would have been sufficient to produce them.

Hence, the prick of a needle often produces  
phlegmon,

phlegmon, especially in persons highly irritable, weak, or diseased, and who, in this case, are said to have *bad flesh*.

Inoculation with the vaccine matter produces also the same series of general phænomena, and the phlegmon arising from it exhibits a constant and invariable progress; because the substance which occasions its development is always of the same nature. The case of the thorn, that of a simple puncture, and of the vaccine inoculation, exhibit nothing common or essential but the prick, or the impression made by contact on the nerves of the wounded part.

Every prick in a nerve produces a change of state, more or less continued, in the general action of the nervous system: when this new mode of action is continued on the wounded part, it gives rise to phlegmon. This change of state is often only momentary, and so transient as scarcely to be perceptible. But in many cases it manifests itself in an evident manner by a general indisposition, and the peculiar derangement of different functions.

In all cases of pricking, as the presence of the foreign body in the part, and its transmission into the mass of the blood, are not necessary to produce the general derangement and particular formation of the phlegmon, the hypothesis of absorption is entirely unsupported by proofs.

Of



Of the numerous causes of phlegmasiæ, those which exercise the greatest action on the nerves are, in general, the substances secreted or disengaged from organized bodies in a state of disease or of putrefaction.

Hence, after a prick made in dissecting a dead body in a high state of putrefaction, that is to say, by the contact of the cadaverous molecule, at a certain period of decomposition, with some of the nerves of the hand, there may take place in the course of a few days redness, swelling, heat around the wounded part, and then shooting pains, which gradually increase in a continued manner, so as at length to become insupportable.

These first local phænomena are soon followed by a general derangement of the functions. Hence, there come on: pain in the head, weakness and confusion of the senses, transient delirium, prostration of strength, shivering, acceleration of the pulse and of respiration by paroxysms; greater heat of the skin, sweats, loss of appetite, new mode of action in most of the organs of secretion, &c.

This series of phænomena, which assume the name of fever, vary indefinitely, according to the causes, and to the disposition of the individual.

After the swelling has acquired a certain degree of intensity, it gradually subsides, as well as the febrile symptoms: if the latter continue to increase

crease there is formed a collection of pus, which is sometimes re-absorbed, or which distends the skin, bursts it, and is discharged.

But when the weakness is excessive no purulent collection is formed; the progress of the phlegmon is suspended, and it may happen that the wounded part will gradually lose its action. It then assumes a blueish, livid tint, becomes indolent, and falls into a state of gangrene.

In the last place, if the strength is re-established, and if the febrile symptoms cease, the wounded part gradually resumes its vitality, the dead parts detach themselves, and there remains an ulcer which cicatrizes slowly from the circumference towards the centre.

Phlegmon being an affection peculiar to the cellular tissue, it may take place in all the organs provided with it. Its size varies, from the pustule scarcely perceptible, to the tumour which contains sometimes more than a pint of pus. When the phlegmon passes through all its stages it terminates in an abscess; but it may stop at any of its periods: abscesses which already contain a large quantity of pus are often seen to disappear in a short time. In this case, the purulent matter has been decomposed or digested, and transformed into *moleculæ* susceptible of returning into the torrent of circulation, or of being thrown out by the usual excretory passages.

The

The progress of phlegmon is generally stopped when there comes on a sudden derangement in some other part: the coincidence of these two phænomena has given reason to think that the pus proceeds to the part newly affected, to produce there, by its presence, the symptoms before observed. From this circumstance the whole theory of metastasis has originated.

Thus, for example, a man has on his thigh a phlegmon which begins to enter into a state of suppuration; boiling water falls upon one of his legs, and the tumour disappears. The latter may be dissipated also, if he experiences a violent cold, or meets with any unexpected event in which he is deeply interested, and which engages his attention for some time. In all these cases, the pus of the phlegmon has not proceeded to the legs, nor to the breast, nor to the intellectual organ: these are only varied phænomena of the nervous action, which succeed each other, and assume each other's place according to the ratio of their intensity.

In all cases of phlegmon, the product of the secretion becomes an irritant, which may at length give rise to further accidents: thus its continued presence around a bone may produce caries, &c.

From these observations it is clearly seen how ridiculous it is to be continually endeavouring to make a phlegmon suppurate; which always prolongs the disease, and often produces ugly cicatrices, without any advantage.

Pretended resolvents and discutients, habitually employed, seldom produce any action. A phlegmon may be checked in its progress by all those means which are proper for determining a strong and continued action towards another part.

In a word, it often happens that nature sports with all our means, and brings to suppuration those tumours which we are desirous of suspending, and suspends those which we wish to bring to a state of suppuration.

A phlegmon may take place not only in the cellular tissue surrounding the different parts, but also in the parenchymatous substance of some of the organs, such as the lungs, the liver, the kidneys, &c. It then exhibits numerous varieties which depend on the structure of the affected organ, on the disposition of the individual, on the rapid or slow progress of the phlegmon, &c.

A part may be affected without any direct impression, and merely by means of its relation with other organs. Hence phlegmonous tumours are not always the result of the action directly exercised on the nerves of the part where they take place; they often arise from a remote cause: of this kind are those formed around the glands at the end of several acute diseases, such as buboes in syphilis, &c.

In all cases of phlegmon the termination is the speedier

speedier as the constitution of the individual affected is stronger.

In the different classes of vertebral animals, the cicatrization of wounds, the development and progress of phlegmonous tumours, are absolutely the same as in man, and exhibit no essential difference.

193. The serous membrane which lines the thorax, the abdomen, the cranium, and the articular capsules; which covers the lungs, and forms the exterior tunic of the stomach, the intestines, the bladder, the matrix, &c. exhibits in its phlegmasic affection peculiar phenomena.

This affection, in its rapid progress, produces excruciating pain, and suddenly gives rise to a series of febrile phenomena exceedingly violent and almost continued.

The affected membrane swells; and, instead of the fluid which habitually exudes from it, secretes in abundance a thick albuminous fluid, which coagulates into flakes or lumps that float in the serosity, or into a thick membrane, which produces adhesion between the contiguous surfaces of the serous membrane.

The albuminous fluid secreted in phlegmasia of the peritonæum is found in curds amidst the serous fluid of the abdomen, and resembles, in some measure, the concrete caseous part of milk floating in  
the



the serum. After difficult births, the matrix sometimes experiences a sort of phlegmasia, which spreads along the peritonæum, and gives rise to a fever which often proves mortal (*puerperal fever*). Several physicians have considered the albuminous substance then found in the abdomen as effused milk; but this supposed milk is found in men as well as in women, after all those phlegmasiæ of the serous membranes of the abdomen which have had a fatal termination, and particularly after the operation for a strangulated hernia.

It seems probable that the vulgar error of milk diffused throughout all the parts of the body, has arisen from this erroneous idea, that milk is susceptible of being effused into the abdomen. It is astonishing to find persons of good sense who consider rheumatic pains as the effect of effused milk, and who seriously believe that there are remedies capable of causing the milk in its curdled state to be evacuated by stool, even a great number of years after the individual has been delivered.

Acute phlegmasiæ of the serous membranes are always dangerous, and often fatal. It is of great importance, therefore, to discover them at their commencement, in order that the means proper for eradicating them may be employed. The principal means on which a dependance can be placed are, to weaken the general action of the nervous system, when the fever exhibits no pernicious

cious character, like that called the puerperal; and to excite strong, continued, and varied irritation in other parts than that which is affected.

The ferous membranes may also be the seat of chronic phlegmasiæ, which increase very slowly; which are almost always mistaken at their commencement, and over which art has very little power.

Domestic animals are subject to acute affections of the ferous membranes, which exhibit a series of symptoms analogous to those observed in man.

194. The white fibrous tissues which terminate the muscles and surround the articulations experience a sort of phlegmasia, which for the most part seems to be produced by the long continued action of a particular damp cold. It rarely attacks robust persons continually exposed to the inclemency of the seasons; but more readily the inhabitants of large cities, of a weak constitution, and who are seldom exposed to the action of the weather.

This rheumatic affection announces itself by a sort of painful torpor in a certain part, which increases sometimes to such a degree as to become a lacerating pain. It is often accompanied by swelling with redness, great sensibility of the skin, and difficulty in the muscular action. These first symptoms are frequently attended

with a series of febrile phænomena, which are often exceedingly violent.

One peculiar character of this affection is, that it suddenly shifts, or ceases in one part to re-appear in another. It thus often shows itself alternately in all the articulations, and even returns to the first.

Rheumatism varies, both in regard to its duration and to its intensity, from a simple fleeting pain, which scarcely lasts a few days, to a general affection which confines the individual to bed for five or six weeks.

After parturition, women being weak and exceedingly sensible to cold, frequently experience rheumatic affections, which by some are considered as *effused milk*.

Rheumatism often takes place without febrile symptoms, and without swelling of the parts. In this case, it announces itself by pains, more or less acute, which return by paroxysms, and sometimes become intolerable.

In some cases these pains give rise to a swelling of the periosteum of some of the parts, and are then generally considered as symptoms of syphilis.

It is to be remarked, that it is always to syphilis, or to the pretended *effused milk*, that all those diseases the character of which cannot be easily determined are ascribed; and when cured by the means used for such affections physicians think

themselves authorized to say: "Such a disease yielded to *mercurials*, consequently it was venereal; such another disappeared in consequence of using those purgatives called *antilactics*, and therefore it arose from *effused milk*." Those who reason in this manner evidently show that they are bad logicians.

When rheumatism affects the articulation of the ribs and the intercostal ligaments, the movements of the thorax are impeded, and the difficulty of respiration frequently becomes very great; which often occasions error, and excites apprehension of a disease of the lungs.

The small articulations exhibit in the gout an affection analogous to rheumatism; but which, however, is very different from it in the aggregate of its accessory phenomena, of its causes, &c. It contracts a sort of regular or irregular periodicity, with an uniform or anomalous progress.

The action of the damp cold which excites phlegmasiæ of the white fibrous membranes, often produces those also of the mucous membranes; so that these two orders of phlegmasiæ sometimes take place by alternation, and reciprocally suspend each other: which occasions a belief that in this case also the humour proceeds from one part to another. Thus it has been supposed that the gout can ascend to the stomach, or proceed to the bladder, &c.

Acute



Acute rheumatism is sometimes checked at its commencement by means proper for diminishing the powers, and by exciting in the gastric organ a point of irritation frequently renewed.

The pains of chronic rheumatism are difficult to be removed. They appear, however, to have been diminished by an increased action of the skin, and of perspiration, by means of dry friction, clothes of waxed taffety, &c.

In a word, this order of diseases exhibits also several very obscure points, which are deserving of further observation.

As this order of diseases is excited, for the most part, by the unaccustomed action of damp cold on feeble individuals, animals which, in general, exhibit more vitality, and which are habituated to all the variations of the atmosphere, do not seem to be subject to them.

195. As the essential use of the mucous membranes is to secrete fluids proper for lubricating the pneumo-gastric and genito-urinary passages, and to furnish digestive juices, the phlegmasiæ of these parts must manifest themselves chiefly by a change in this mode of secretion.

When a part of the mucous system has received the impression of any foreign cause whatever, either direct or indirect, a sensation of straitness, dryness, and ardour, is experienced in that part. The habitual secretion is suspended, the sides of the mucous



organ swell, febrile symptoms appear, and in a few days there is secreted a large quantity of a new, limpid, and highly irritating fluid.

As the other febrile symptoms disappear, the product of this new mode of action becomes insensibly thicker, and less irritating; the mucous organ gradually resumes its usual function, and secretion its natural character.

In this order of diseases the new secretion always strongly irritates the organs on which it is effused, and produces further accidents, variable according to the uses of these organs. It is this secretion which occasions sneezing in coryza; cough and difficulty of breathing in colds; tenesmus in dysentery; frequent desire of voiding urine in gonorrhœa, &c.

The peculiar secretion which results from this new mode of action was long considered by physicians as the direct cause of the disease, while it evidently appears that it is only the product of it.

They were of opinion that the disease arose from a *humour* which infected the mass of the fluids, and that nature endeavoured in this manner to free itself from it.

This hypothesis must have first been formed at a time when physiological knowledge was very limited: on it was founded humoral medicine, which was easily applicable to all diseases. It was indeed supposed, that as a humour evidently appeared

peared to be the cause of disease in catarrhs, it might exist also in all other cases, though in a manner less apparent; and every time that a spontaneous alteration took place in the structure or function of an organ, it was said that the *morbific humour* had proceeded thither.

This theory soon obtained credit, and at length became popular, because it was exceedingly convenient to account for every thing to persons who had no idea of the laws of organization, and because the means of cure most commonly employed seemed very often to support it.

In the supposition of a humour which proceeds to a certain part and deranges its action, it was natural for physicians to endeavour to divert it, by making it issue through the skin, or by evacuating it by stool or by urine; and as they were obliged, in order to produce this effect, to irritate very strongly some other part, they in this manner often destroyed the foreign action which constituted the disease. But it may be readily conceived that this practice, founded on a false theory, must have as often proved fatal as beneficial.

The new mode of action which is established in catarrh may be suspended, in the commencement, by all those means capable of exciting a powerful and continued action in some other part than the affected membrane. For this reason, emetics employed so as to produce nausea, and repeated severe

ral times, succeed so often in catarrhs of the ærian passages.

This new mode of action may be changed also by applying to the affected membrane a new irritant, more energetic or frequently repeated. In persons of a good constitution, catarrh terminates spontaneously at the end of a period which varies from some days to some months, according to the organ affected, the nature of the irritant, and the disposition of the individuals, &c.

Catarrhs may be indefinitely continued by the repeated application of the same irritants which produced them; by local or individual weakness, and by the force of habit.

The cause which for the most part produces catarrhs of the ærian passages (colds), is the sudden impression of damp cold air, in a state yet unknown, on the nerves of these parts. Persons of a weak constitution, and not accustomed to breathe this air, receive the impression of it sooner than others.

The action of this damp and cold air on the ærian passages is stronger, according as the temperature of the skin is higher; so that people will more certainly be attacked, the more they endeavour to secure themselves by the common means.

To remain, therefore, in winter continually shut up, to be always warmly clothed, or to go abroad when heated, are the sure means of acquiring the

disease by the first impresson of cold damp air on the lungs. On the other hand, those thinly clothed, those habitually exposed to the air, and those who avoid overheating themselves, are scarcely ever subject to colds.

The action of the cold damp atmosphere may affect a part of the mucous system, without making a direct impresson on it, but by exercising an action on a distant part. Hence, damp cold in the feet produces catarrh of the aërian passages, and often also of the intestinal surfaces.

We are taught by observation, that the oftener people have been attacked by catarrh, the more readily they are affected by it; and that the longer a catarrhal disposition has continued, the more difficult it is to be destroyed.

In gonorrhœa, the product of the secretion is contagious, and the application of it to the genito-urinary membrane of another individual produces the same affection: the latter, in like manner, may be propagated indefinitely by means of contact.

It is, in all probability, the contagious character of this sort of catarrh that renders its progress so tedious, and its termination often so difficult, when left to itself, in individuals of a weak constitution.

This urethral catarrh may be cured pretty soon by means of stimulating injections, which change  
the



the contagious mode of secretion into another not contagious.

When catarrhs are frequently renewed, or have continued a very long time, they often give rise to chronic affections exceedingly troublesome: of this kind are callosities in the urethra, leucorrhœa, vesical catarrh, catarrh of the ærian passages, phthisis pulmonaris.

In the last mentioned case, when continued emunctories are established (cauteries, vesicatories), with the intention of producing a *derivation of a humour*, the only effect obtained in general is, to have two diseases instead of one; and both tend equally to weaken, by drawing off juices rich in nutritive parts, and more speedily bring on consumption.

Domestic animals are not much subject to catarrhal affections, because they are more habitually exposed to the variations of the atmosphere; but those which, by a peculiar structure of their nostrils, are apt to have the glanders, exhibit in that sort of coryza a catarrh much more troublesome than any of those which affect the human species.

196. The mucous membranes which line the pneumo-gastric and genito-urinary passages, are continued with the skin on the edges of different natural apertures; and it might be said, that in  
these



these parts the latter is folded back to line these different cavities. It is observed, also, that the cutaneous and mucous systems have a great relation in their reciprocal functions.

It cannot, however, be denied, that these two systems of organs exhibit very striking differences in their intimate structure, especially during various diseases to which they are subject.

Affections of the skin exhibit a new mode of action and secretion, with or without alteration in the intimate structure of that organ.

They may arise merely from the secretion of the skin being increased or changed; or they exhibit themselves under the form of eruptions, of divers forms and sizes; of phlegmonous pustules; furfuraceous, squamous, scabby, or ulcerated spots.

In some cases, the product of the morbid secretion is contagious.

In robust individuals, whose skin is continually exposed to the air, this organ becomes brown and tanned, insensible to all impressions of the atmosphere, and is subject to no disease.

On the other hand, cutaneous affections are numerous among the civilized nations of temperate or warm countries, who live in a luxurious manner, and whose skin habitually sheltered is highly sensible to the action of all irritants which come in contact with it. They are more frequent, also, among individuals who, being born with

with these dispositions, remain in a state of poverty and dirtiness. The latter are exposed to a great number of foreign irritants, and to the reaction on the cutaneous organ of the products of its secretion. In some cases of denudation, or of disease, this produce often exhibits an exceedingly acrid and highly irritating character. It is probable, that a concurrence of analogous circumstances has given rise to the greater part of cutaneous diseases.

It appears that the Greeks preserved themselves from diseases of the skin, which among them were exceedingly frequent and severe, merely by the habitual use of bathing and of unctions.

Bathing strengthens the skin by habituating it to the contact of a fluid eight hundred times denser than atmospheric air, and cleanses it from the products, more or less irritating, of its secretion. Ointments, like a light varnish, preserve it from the too immediate contact of a great number of foreign and stimulating substances, without in any manner impeding its excretion.

It is well known that the Grecian baths were establishments exceedingly magnificent, and that they constituted the most remarkable of their public monuments.

Cutaneous affections, in some cases, are the necessary consequence of an epidemic or sporadic fever; in others, they are the result of a foreign mode

mode of action excited in some of the organs\*: but, for the most part, they arise from the immediate action of some irritants on the skin; and in all these cases they vary as the causes which produce them.

Most cutaneous affections terminate spontaneously at the end of a certain time, and require no treatment. Others are indefinitely continued, during an unlimited time, either by the force of habit, or by the repeated contact of the contagious product of secretion. In such cases, the physician endeavours to substitute in the place of these obstinate affections, others which do not exhibit that character, and which cure themselves spontaneously, and to produce in another organ, such as that of digestion, a strong and frequently renewed action.

The itch is an eruption without fever, the product of which is contagious. It is readily propagated by means of contact, especially among persons a prey to wretchedness and dirt, among whom it becomes, in some measure, endemial. It is cured by all those means proper for exciting in the skin another mode of action, such as friction, and all irritating substances. A recent itch may be speedily removed; but the longer it has continued the more difficult is the cure.

\* Dr. Lorry always experienced a cutaneous eruption when he ate rice.

Among

Among persons who have a delicate skin, friction for the itch soon produces another eruption, which the surgeons consider as psoric. This new eruption, which may be afterwards maintained by dirtiness and useless frictions, has often been considered as an obstinate itch, and as such has been several times treated without success; but it always yields to means proper for allaying the irritation of the skin, such as rest, bathing, unctions, the use of fine linen, &c.

No eruption but that the product of which is contagious ought to be considered as the itch. When this disease has continued a long time, it leaves in the skin a disposition for producing, at certain periods, and often for several years, a new eruption, which is not contagious, and which ought not to be considered as psoric. In the pustules of the itch there is often found an animalculum (*acarus scabiei*), which has been differently described by naturalists, and to which are ascribed the production and propagation of the disease; but this assertion has never been properly proved.

Tinea is cured by a pitch-plaster, in the form of a cap, which tearing up the whole scabby stratum forms a new wound, the cicatrizing of which is then spontaneously effected. This disease would, in all probability, yield to a less violent remedy.

Herpes,



Herpes, which has so great a similarity to tinea, yields only to analogous means.

In a word, the case is the same with all old ulcers, which are continued by the force of habit, and whose hard and callous edges oppose cicatrization. When transformed into a recent wound they often heal very speedily.

An affection of the skin may suddenly disappear, when a stronger derangement takes place in another organ. In these cases, the vulgar believe, that the disease of the skin has been driven inwards, and that it has proceeded to the part newly affected; but this disappearance ought to be considered merely as the consequence of the strong action of an organ which suspends a slighter in another part. When the eruption is recalled, an effect analogous to that of a vesicatory is obtained.

Animals in the savage state do not seem to be subject to any diseases of the skin; but among those which we subdue, and confine together in close, damp, and gloomy places, or which receive an insufficient quantity of food, or aliment of a bad quality, cutaneous affections of a very noxious character soon manifest themselves.

197. The glands of the lymphatic system, the other glandular organs, and the white fibrous tissues,



tissues, are susceptible of a peculiar phlegmasia, the progress of which is, in general, very slow.

When a gland is irritated, either directly by the contact of a foreign body, or indirectly by the action of another part upon it, the gland tumefies, and gradually becomes indurated. At first, a small round indolent body is felt, which progressively increases; others arise around it; and the tumour often becomes very large, hard, and unequal; it remains a long time moveable, and produces no other inconvenience than that which results from its weight and its position: but at length it forms adhesion with the neighbouring parts.

The cellular tissue, which surrounds the gland, often enters into action, and exhibits the whole series of the phenomena of phlegmon. Sometimes, during this operation, the glandular affection ceases. When it persists, it continues its progress as if the phlegmon had not taken place.

By opening the bodies at different periods of glandular tumours, it has been found that they have acquired the consistence of concrete albumen; of lard more or less hardened; or of a cartilage, in the midst of which a few ossified points are sometimes observed.

Scrophula is an affection of this kind, which seems to arise from a certain state of weakness, a  
peculiar

peculiar constitution, for the most part hereditary: its symptoms seem to show themselves more readily on those organs least susceptible of reaction, and which may be said to be endowed with less vitality.

A scrophulous constitution is announced by a delicate white skin, flabby fullness of the flesh, blue and often watery eyes, bushy chestnut-coloured hair, the alæ of the lips and nose thick, the lower jaw broad, a particular acuteness and delicacy of the senses, and often a premature intelligence.

This constitution appears chiefly in large ill-built cities, damp, and looking towards the north. Among children it seems to be the result of an excess of nourishment with want of exercise.

When this peculiar disposition exists, a point of irritation is soon observed to be developed in some of the glands; those, for the most part, of the neck and mesentery in children; those of the lungs in adults, and sometimes in several of the articulations. In all these cases, the irritation determines the series of phænomena peculiar to the glands, and to the white organs.

A scrophulous constitution, when it begins to manifest itself, may be easily changed by the use of different stimulants, wholesome nourishment, exercise, and good air; bitters, tonics, &c. frequently varied.

Scrophulous symptoms often disappear in consequence of some acute disease, small-pox, &c. They frequently disappear at the age of puberty, when the vital force assumes a new action and a greater degree of energy : if they persist after this period, they generally continue for life.

Rachitism is a peculiar state of the constitution, which seems to have the greatest analogy and often to be confounded with scrophula. It, however, differs from it in this respect, that it affects in a more essential manner the system of the bones. In this disease the bones become soft and swelled, and the motion and weight of the body bend them, and often produce the most frightful deformity.

This disease yields sometimes to the use of the general means indicated for scrophula. The flexion of the bones even may be corrected, when not very great, by the continuance of any action that tends to straighten them.

198. Syphilis in its history still presents a great number of obscurities. To have a clear idea of them, it will first be proper to take into consideration the primitive chancre. We shall, therefore, suppose that an ulcer in the genitals may have assumed, by a concurrence of very extraordinary circumstances, such a character, that the product of its secretion, deposited afterwards on a part destitute of epidermis, in another individual, gives rise  
to

to the formation of a similar ulcer, and that this kind of ulcer may then be propagated indefinitely by the means of contact.

An ulcer, in consequence of its being contagious, must be perpetuated in the individual in whom it exists, producing that ravage which is peculiar to it, and must occasion, in the whole of the nervous system, a particular change of its state.

In syphilis this change is such, that it gives rise to subsequent accidents, which appear more readily in some of the mucous membranes, in the lymphatic system, and in that of the bones.

In syphilis, therefore, we ought to consider:

1st. The primitive chancre, whatever be its form, which varies according to the place where it exists.

2d. The peculiar action of the nervous system which it maintains.

3d. The consecutive symptoms produced by this action.

The primitive chancre may be easily cured at its commencement, by all those means which are capable of changing the nature of an ulcer. Thus, profound cauterization of a recent chancre is sufficient to destroy it. When of long standing, mercurials, violent sudorifics, drastic purgatives, the use of some mineral acids, of some alkalies, and in general of all those means capable of producing

and maintaining a great change in the system, cause a termination of this morbid affection.

But syphilis which has not been checked in its progress often produces subsequent accidents exceedingly troublesome; such as consecutive chancres in different distant parts, buboes, periostitis, exostosis, debility, with pains in the limbs, caries, general atrophy, and a sort of consumption which may become fatal.

It is probable that the product of the primitive chancre can alone propagate the contagion. In the different states of syphilis all the means capable of exciting in the system a strong and continued action, during a period proportioned to the time the disease has existed, always cure the primitive chancre, and destroy the specific action which maintained it; but the subsequent accidents can be cured only by pursuing a course peculiar to them, and as if they had been produced by some other cause. These accidents often persist, because improper regimen and remedies maintain the patient in a state of debility which does not allow the organization to make the effort necessary for effecting a cure; and they frequently cease when all treatment is abandoned, and when a regimen proper for restoring the strength is observed.

This simple explanation of the common progress



gress of syphilis is sufficient to account for all the forms it assumes, for the nature of the accidents it produces, and for the cause of the success or failure of all the means employed to counteract it.

A great number of chronic affections, which take place at a longer or shorter period after the appearance of syphilis, are frequently considered as maintained by this disease, and consequently are treated with mercurials. For the most part they do not yield to this improper treatment; but even when a cure is effected it is ridiculous to conclude that the malady was of a syphilitic nature. Mercurials produce their effect on the organization by exciting an energetic mode of action, which may be useful in a great many diseases.

199. Syphilitic blennorrhagia (gonorrhœa) seems to have the same origin as syphilis: it however exhibits a character so distinct that it may be considered as an affection of a peculiar kind. It consists of a catarrh of the urethral membrane, or of the vulvo-uterine conduit. The product of this catarrh is contagious, and when applied to the genital parts of another individual produces the same affection.

This blennorrhagia, after continuing about a month or two, spontaneously ceases; or, if it continues longer, the secretion gradually loses its con-

tagious property, and the disease is changed into a simple chronic catarrh.

In some women, however, blennorrhagiæ of a long standing become, under certain circumstances, contagious in the act of coition.

Syphilitic blennorrhagia, in general, ceases spontaneously at the end of a limited period; but it may be cured much more speedily by stimulating injections, which change the contagious nature of the secretion.

Syphilitic blennorrhagia, like all catarrhs, produces a general derangement, which, after the commencement, is often exceedingly violent. It sometimes gives rise to derangements, which take place chiefly in parts having a very intimate relation with the organ affected, such as the glands of the groin and the testicles.

When gonorrhœa is succeeded by a swelling of the testicles, this new affection is sometimes so strong that the running is immediately suspended. In this case it may be proper to renew the secretion of the urethra, which is always free from danger, in order to remove the disease of the testicle, which is much more severe; but it is entirely useless to endeavour to revive for this purpose a syphilitic blennorrhagia: the same result may be obtained from a simple catarrh excited by any irritating injection.

It

It is highly probable, that the secretion of a chancre applied to the membrane of the urethra, or of the vulvo-uterine conduit, may sometimes produce a syphilitic blennorrhagia; but it is not probable that the product of a gonorrhœa can occasion a chancre.

200. The tissue of the lymphatic glands, and that of the glands appropriated for special secretions; the tissue of the white fibrous organs; that of the bones, and even the skin, in consequence of any irritation, are susceptible of experiencing a sort of phlegmasia, the progress of which is generally very slow, and the result always uniform.

This chronic affection of the glandular or white fibrous tissues manifests itself, for the most part, after an acute phlegmasia of the other cellular, mucous or serous tissues by which they are surrounded. Sometimes it is produced directly by any irritation whatever. In all these cases, there first appears a hard, indolent tumour, which increases very slowly, and at the commencement produces no other inconvenience than that which naturally results from its position and its size, and from the derangement in the function peculiar to the part affected.

These tumours, when examined at different periods of their formation, exhibit a homogeneous substance, the consistence of which has a resemblance to that of concrete albumen, indurated

lard, or a cartilage more or less compact, in the midst of which there are sometimes developed a few ossified points\*, or in which are found some cretaceous matters; and on this account these tumours have been distinguished by the name of *scirrhus*. Of this kind are those tumours formed in the glands of the breast, after external læsion; those which take place in the lymphatic glands of various parts, in the case of scrophula; those small tumours which are observed in different points of the substance of the lungs; in phthisicky persons; the swellings which arise in the œsophagian and pyloric orifices of the stomach; in the uterus, the ovaria, the prostate gland, at the neck of the bladder, in the rectum; the tumefactions of the white tissues which surround the articulations; the different exostoses with a softening of the bones; the tumours in the cellular tissue, after phlegmons which are said to terminate by induration; and, in the last place, those tuberculous pustules which arise on the skin, and chiefly on the lips, the alæ of the nose, &c.

All these affections, which appear to be so different, and which seem to have no relation with each other, are however of the same order; they follow the same progress, and exhibit the same mode

\* An analogous state, but without increase of size, takes place in almost all the soft parts exposed to long-continued compression or friction. Old age also frequently brings on a similar state in the tissue of the arteries, tendons, &c.

of termination. Notwithstanding the varied symptoms which necessarily result from the peculiar structure and numerous uses of the injured parts, the scirrhus affection seems to bring them all back to the same state, by giving them the consistence of concrete albumen.

These different tumours, when they attain to the scirrhus state, may remain several years without making any progress, without increasing in size, and even without producing much inconvenience.

Sometimes, after remaining for a very long period in a state of repose, they may again acquire a progressive state, if excited by any new cause.

These tumours sometimes disappear when recent and not voluminous, in individuals of a strong constitution; but when they have once attained to a certain size, when of long standing, and if the persons be debilitated, they are no longer susceptible of a spontaneous cure.

In this case, the other parts of the same system of organs, or of an analogous system, contract a great disposition to a similar mode of affection, which establishes a peculiar constitution or diathesis. Thus the scirrhus of the glands of one of the breasts, when of long standing, is generally accompanied with that of the neighbouring lymphatic glands, and with scirrhus of  
the



the opposite breast; and when the tumour has made a considerable progress, the whole glandular system is in general affected.

The medical art can furnish no other means of checking the progress of this evil, but extirpation of the tumour when practicable, and the different perturbing modes of excitement, capable of changing the scirrhus constitution, when not too inveterate, and when its effects have not been far extended.

The pretended dissolvents are scarcely ever of any use; and caustics, for the most part, are hurtful.

When the scirrhus tumour has attained to a certain degree of increase, it frequently happens that a new mode of action is excited, in consequence of a blow, the application of a caustic, of a phlegmen which takes place in the neighbouring parts of the tumour, and of any other irritating cause. This hard homogeneous and indolent mass, which seemed to have lost its whole organic structure, acquires then great sensibility, and experiences a series of very remarkable phenomena. There first comes on a slight titillation, with a troublesome itching, followed by more acute pains, which return by paroxysms; in a little time the heat of the part increases; the tumour becomes more voluminous and unequal; the skin assumes a reddish brown tint, and at length

length there is formed an accumulation of pus, sometimes thick, but for the most part of a reddish fluid, which is discharged by the bursting of the skin. Soon after the secretion, when it comes into contact with the atmospheric air, changes its nature, and there are then evidently observed all the phænomena of real putrefaction, which the weakness of the part does not permit to be suspended, but which is modified by a remainder of vitality.

The pains, however, increase with the size of the tumour; the ulcer is enlarged, exhibits an unequal surface of a livid brown colour, and its edges become hard, projecting, and inverted, &c. The skin which circumscribes the tumour is of a violet colour, and covered with varicose veins.

In the course of the disease, the *cancer* slowly destroys all the parts which it affects, and even the bones; the destruction of the venous tissue produces frequent hæmorrhagies. When the cancer spreads to the neighbouring parts, the one primitively affected exhibits sometimes an ugly scar, rough and depressed.

It may be readily conceived that an affection so terrible, accompanied, for the most part, with excruciating pains, cannot long continue without producing disorder in all the other functions; they indeed all become deranged in succession,  
and

and the patient, at length, falls into a state of consumption, which terminates in death.

The animals, which we render subservient to our wants, are not exempted from affections of this kind ; but they are more rarely attacked by them, as they are better calculated to resist those causes by which they are produced.

201. The bones are susceptible of phlegmasiæ, as well as the soft parts ; but in the bones their progress is much slower.

In fractures, as well as in wounds, the broken extremities grow soft, swell, become painful, and secrete at first a bloody and serous matter, and then a thick gelatinous fluid, which forms an incrustation on the fractured ends. This fluid, in exuding from the two separated surfaces, is confounded with them, and forms a cartilaginous substance which produces a ring, always apparent in the place of the fracture, and which fills up the cavity of the long bones. This cartilaginous substance then passes to the osseous state, according to the habitual mode of the development of the bones ; and thus produces a consolidation of the fracture.

Fractures, as well as wounds, are consolidated more speedily, according as the separated surfaces are more carefully preserved in a state of rest in  
their

their respective situations, and as the individuals enjoy a better state of health.

The time necessary for the formation of the callus varies from a fortnight to several months, according to the nature of the fracture, the age and disposition of the individual, &c.; but the mean term is from thirty to forty days. In some diseased or highly debilitated persons, the consolidation of fractures may not take place; it may also be prevented or retarded when any powerful action, maintained on the organ, suspends the process of ossification.

When the fractured parts have remained separated for a long time, they both become incruusted with a cartilaginous substance, which acquires an osseous nature; and the two ends, retained by an intermediate ligamentous substance, form a sort of articulation. In this state the fracture cannot be consolidated but by excision of the ends of the bone.

When a bone has received a violent contusion, or when it remains some time exposed to the air, it becomes dead in a greater or less extent of its surface and depth; a vascular apparatus under the form of granulated and carneous pustules is developed at the surface of the sound bone; the dead part gradually detaches itself, and at length is completely separated at the end of a certain time,  
the

the duration of which in general is in proportion to the thickness of the part which has *exfoliated*.

Those substances, to which the property of hastening the exfoliation of a bone has been ascribed, are scarcely of any utility.

When the bone of a limb is mortified throughout its whole extent, the circulation between the periosteum and the medullary reticulation is interrupted; the bone, become a foreign body, produces several phlegmons in the neighbouring cellular tissue: these tumours suppurate, and remain fistulous. The phosphate of lime, which can no longer distribute itself in a uniform manner at the surface of this bone, diffuses itself irregularly around it; gradually assumes its place, and produces a new shapeless bone, in the middle of which the old one is inclosed. This dead bone occasions by its presence, in the middle of the new osseous production, pains which are often excruciating, and which render the extraction of it necessary when possible. During the whole course of the disease, the mortified part produces and always maintains fistulous ulcers, even through the new bone, which is thus perforated with several holes.

This mortification may be produced artificially in an animal, by making an aperture in a long bone,



bone, in consequence of which the structure of the medullary reticulation may be altered. (*See Les Expériences de Troja.*)

When the mode of action of the vascular tissue of a bone has been changed by any cause whatever, this organ may become altered and swelled; in which case the secretion of the phosphate of lime is increased or diminished.

Thus the violent contusion of a bone; the presence of some phlegmons or chronic ulcers in the neighbourhood; the general action maintained by syphilitic, scrophulous, scorbutic, and cancerous affections, and all diseases which, by their long duration, have greatly exhausted the vital forces, may produce a change in the natural action of the vascular tissue of one or more bones.

Sometimes the secretion of the phosphate of lime is diminished; the bone bends, and is easily broken: at other times its vascular tissue is gradually weakened or destroyed; in which case the solid part of the bone becomes brittle and friable.

In some cases, the bone swells, and the secretion of the phosphate of lime increases to such a degree, that the accumulation of it may give to the bone the consistence of ivory.

This eburneous exostosis may produce no other inconvenience than that which results from its size and position.

In

In other circumstances, the vascular part swells, and is sometimes considerably puffed up; the secretion of the calcareous salt decreases, and the bone gradually loses its consistence, and assumes that of cartilage. At other times, the vascular tissue, by increasing in volume, separates and distends the laminae of the bones; and the result is a large carniform mass, which supports in part a light cavernous skeleton formed by the osseous fragments and asperities.

Sometimes the swelling of the bone takes place very speedily, with redness, heat, acute pains in the part, and febrile symptoms: At other times it is produced slowly and with very little inconvenience. The disease may suspend its progress even for a very long time, such as several years, and afterwards resume it.

When the osseous tissue has attained to a certain state of weakness, with a peculiar mode of action, whether the bone be in the neighbourhood of chronic phlegmons or ulcers, or only in contact with the atmospheric air; or, whether it has increased in size, especially by assuming a cartilaginous consistence, this osseous tissue may acquire an action analogous to that acquired by the soft parts, during the phenomena of gangrene or ulcerated cancer; and may produce ichorous or sanious pus, which will effect a solution or decomposition of the osseous organ.

*Caries* makes a more rapid progress when it affects the spongy bones, and when it takes place in contact with the atmospheric air. It is the more difficult to be checked as the individual is more debilitated.

The progress of caries may sometimes be checked by complete excision of the diseased part, or by cauterization; and by all those means capable of restoring strength and energy.

In all diseases of the bones it must always be remembered, that it is the vascular tissue alone which exhibits the phenomena of disease, since it alone is the living organ, and because the alterations which take place in the secretion of the phosphate of lime are merely the result of the mode of affection of that tissue of vessels.

Draught animals, whose muscular exertion we continually employ, are exposed to violent efforts which may often give rise to diseases in their osseous parts; and we indeed find among them all those modes of alteration of which that system of organs is susceptible.

202. From this cursory view of the numerous phlegmasiæ to which the different parts of the organization are subject, several important truths may be deduced.

They are all produced by an impression made directly or indirectly on the organ affected, by an

irritating cause, which altering, more or less, its organic structure, gives rise to a change in its mode of action.

Robust men and animals resist the greater part of the causes of phlegmasiæ; and those which in such men and animals result from violent external læsion are always speedily cured.

An organ yields more easily to the impression of phlegmatic causes, according as it is weaker, and as it has oftener experienced their action.

Phlegmatic affections are the more troublesome, and the more difficult to be healed, the older they are, and the weaker the constitution of the individuals attacked by them.

All these affections, in the succession of their phænomena, exhibit a slower or more rapid progress. Almost all the anatomical systems of organs are susceptible of these two modes of action, which restore health, or bring on death by a series of constant phænomena.

The organs affected by phlegmasia experience derangements, which are particularly remarkable in the exercise of the functions peculiar to them. Thus the secretory organs experience changes in the mode of their secretion. The new product, which is evidently the result of the disease, has been considered as the cause of it, and has given rise to the theory of *humours*.

In

In some cases, the product of the morbid secretion, applied to a similar organic part of another individual, produces the same affection, which is thus propagated by the way of contact.

The greater part of the phlegmasiæ may be checked at their commencement, and often suspended in their progress: some reduce the art to mere expectation.

A violent phlegmatic affection removes, in general, one that is less so.

The alternation which often spontaneously takes place between phlegmasiæ of different degrees of strength in different organs, has induced some to believe in a transportation of humours, and given rise to the theory of *metastasis*.

The principal means, employed with advantage in these diseases, tend either to excite irritation in a part different from that which is affected, or to change the mode of action which constitutes the disease, or to remove the products of the secretion, the presence of which may maintain the derangement and produce further accidents.

In acute phlegmasiæ it is, for the most part, proper to diminish the general or local powers, while it is almost always necessary to maintain or to increase them in those which are chronic.

Acute phlegmasiæ soon disappear, produce death, or are converted into chronic. The latter almost



always lead slowly to a state of consumption, which at length proves fatal.

Acute phlegmasiæ disappear by a series of phænomena, which succeed each other regularly in the same order. Art, in general, ought to respect this progress; and its only object should be to remove every thing that might derange it. In many cases, however, and particularly in men of a robust constitution; these diseases may be checked at their commencement, or even suspended in their progress, without any danger.

Art, therefore, may check some of the phlegmasiæ, and favour the progress of the greater part of them; but it cannot cure any of them.

Acute phlegmasiæ bring on death, in consequence of the derangement which the local affection produces in all the functions, and the patient dies by the consecutive effect of the febrile symptoms. An acute phlegmasia produces, with more efficacy, a general derangement of the functions or fever, according as the constitution of the patient is weaker, or more irritable.

In the acute affection, the part may be so far debilitated and enervated as to present only a weak resistance to the laws of chemical affinity: it then exhibits, in the rapid phænomena of gangrene, a real putrefaction modified by a remainder of vitality.

The

The chronic affection may maintain in the mucous membranes, or in the cellular tissue, a more abundant morbid secretion, which continually weakens the individual. Besides, the injured part deranges the functions of the system to which it belongs; the disorder spreads from one function to another, and the patient is carried gradually to a state of consumption, which terminates in death. In other systems of organs, and particularly the glands, the white fibrous tissues, the skin, and even the bones, it happens, in consequence of a slow and gradual alteration, that the part swells, becomes indurated, and assumes the consistence of concrete albumen or of cartilage.

Chronic phlegmasia often remains in this state without producing much inconvenience; but if it again enters into action, it exhibits a termination analogous to that of acute phlegmasia: the debilitated part presents only a weak resistance to the chemical action; and, in the state of cancer and caries, experiences all the phenomena of a very slow putrefaction.

203. It has been seen that acute phlegmasiæ often produce by their acuteness a general derangement in the order of the functions. But there are some other phlegmasiæ which, instead of being the cause of this derangement, seem to be the effect

of it ; of this kind are erysipelas, scarlatina, rubella, and variolæ.

In these diseases symptoms are developed which announce the general derangement of the nervous action ; such as pain in the head, debility of the senses, prostration of strength, loss of appetite, accelerated circulation, derangement in the secretions, at length *fever* ; and towards the fourth day there comes on a cutaneous phlegmasia, general or partial.

In variolous fever, the fluid contained in the mature pustules, either fresh or dried, becomes a stimulant proper for producing the same fever in another individual, when applied, though in the smallest quantity imaginable, to a part destitute of epidermis.

As this pus, for the most part, is secreted in abundance from the whole surface of the body of each patient ; as it is of such a nature that it may be kept a long time in a state of desiccation, on the scales of the pustules, without losing its specific virtue ; and as it may be reduced to very fine powder, so as to be transported to a distance by the winds, and introduced into the ærian passages ; it may be readily conceived that this disease, when once developed by accidental circumstances, must be afterwards propagated without interruption.

It is therefore the action produced by the contact

tact of this substance on the nerves of the touched part, which occasions in the whole system that series of general phænomena which constitute variolæ, and not the absorption of it, and its being conveyed into the general mass of the blood, as is commonly supposed,

The most singular phænomenon observed in this disease is, that, when the individual has once exhibited the series of phænomena which it produces, the organization loses its fitness for being again affected by the variolous stimulant. We are entirely ignorant in regard to this peculiarity, and to the nature of the change which has been effected in the system,

But, since the organization is susceptible of losing its disposition for being affected by the virus of variolæ, it may be readily conceived that other causes than the disease may produce the same effect; and this cause has fortunately been discovered in the virus of the vaccina.

These plain observations are sufficient to show the folly and absurdity of the objections which have been made against employing the vaccine inoculation as a preservative from the small-pox. The fear of a poison introduced into the blood, capable of producing future derangements, can be entertained only by persons entirely unacquainted with the laws of the organization.

The small-pox, communicated to numerous

tribes of people, has often occasioned the most dreadful ravage, by sweeping off a part of the inhabitants, or by rendering them maimed and deformed.

The causes which have chiefly contributed to increase its ravage are those proper for favouring the eruption : these depend on local circumstances, poverty, ignorance, and prejudice.

As the small-pox consists essentially in that fever by which it is characterized, it is highly desirable that the eruption, which is merely a consecutive accident, should be as little confluent as possible. Some physicians are even of opinion that an individual may have the variolous fever without eruption, and be no less secure from a relapse : it is possible that some of those who believe that they never experienced this disease, may have had the fever without any eruption. But the vulgar imagine there can be no small-pox without pustules : they believe that every thing which comes out was formed in the body, and that the more confluent the eruption, the more certain the cure. This popular error, which on the whole is very pardonable, has been the cause of the great ravage of the small-pox ; because all the means of cure have been applied in such a manner as to favour the quantity of the eruption, while the object should have been to diminish it.



A more rational mode of treatment, among enlightened nations, has very much lessened the ravages of this disease; the practice of inoculation has also contributed to render it milder; and it is possible that the vaccine inoculation may extirpate it entirely; but it never will produce this effect unless the practice be enforced by a law, so as to oblige parents to have their children inoculated within a certain period after they are born. Such a regulation, which would tend to prevent the twentieth part of mankind from being swept off at an early period of life, or from being maimed and deformed, would be of the utmost importance to society.

204. In phlegmasiæ, and particularly those which are acute, the local alteration often produces the general derangement of the functions which constitutes fever, and the cause of this affection is then evident. But it frequently happens that the impression, made on an organ by any cause whatever, produces the general derangement of the functions or fever, without leaving any traces of local alteration; which has rendered the etiology of this disease very obscure.

Fever consists in a derangement, more or less complete, of the different functions, with a series of phænomena which tend to bring back to health. This affection may be produced by a  
great

great variety of causes ; thus, the too long continued impression of heat, of dry or damp cold ; marshy exhalations, and all those which proceed from vegetable and animal substances in a state of putrefaction ; violent and forced exercise, a transport of passion ; derangement in the gastric organ by excess or privation of food, &c. may occasion fever.

In this disease, each function is deranged in a manner peculiar to itself, as may be proved by a careful examination. We indeed observe : confusion, exalted sensibility or weakness of the senses ; pain in the head ; prostration of the muscular strength, or *subfultus tendinum* ; irregularity in the movements of respiration and circulation ; shivering or great heat ; derangement of the system of digestion : hence loss of appetite, thirst, mouth dry or clammy, &c. a new mode of action in all the secretory organs, but most sensible in the secretion of sweat, urine, &c.

Though fever always consists in a derangement of the different functions, accompanied with a series of phænomena which tend to bring every thing back to the natural order, it is evident that this derangement may vary in an indefinite manner, according to the causes by which it is produced, the constitution or disposition of the individual, and to the combinations possible in the numerous symptoms which constitute the disease ;  
and

and hence have arisen the thousand and one varieties of fever described by nosologists.

The most striking difference exhibited by fever arises from its progress, which may be either continued with *remissions*, more or less sensible; or return by paroxysms with complete *intermissions*: which establishes the natural division of this affection into *remittent* and *intermittent*.

Remittent fever may be distinguished also, according to the severity of its symptoms, into *simple remittent*, which is never mortal of itself, and *pernicious remittent*, which frequently becomes fatal.

205. Simple remittent exhibits an indefinite series of transient shades of little importance, and difficult to be defined. Among these shades, however, it is possible to establish three distinct forms, with which the different particular cases are connected in a more or less direct manner.

1st. In a young man of a sanguine and robust constitution, the sudden impression of dry cold, violent and forced exercise, a strong transport of passion, &c. may produce a fever, which is suddenly announced by a slight shivering, and increases in a *continued* manner, with redness of the face and eyes; beating of the carotid arteries; slight pain in the head; moist universal heat;  
ample

ample and frequent pulse, &c. These symptoms gradually increase, and terminate at the end of the first, fourth, ninth, or fourteenth day. *Synocha*.

2d. In adults of a strong arid constitution, a firm and irascible character, with a predominance of bile, the same causes as in the preceding case, a derangement of the gastric system, or strong marshy exhalations, may produce a fever, which after some days' indisposition manifests itself by a sudden attack; violent pain in the head; redness in the face, with a greenish yellow tint around the nose and lips; great sensibility in the epigastrium, ausca, vomiting; pulse frequent and full; dry heat; excessive thirst, &c. This fever terminates spontaneously towards the end of the second or third week. *Bilious fever*.

3d. Men of a weak constitution, but for the most part females, and all persons of a pale complexion, relaxed fibres, and a slow character, are differently affected. The same causes, as in the preceding case, produce in them a fever, which announces itself by a long series of phænomena, and which commences its attack in a less sensible manner. The symptoms are: paleness of the face, slight pain in the head; sensibility of the whole abdomen; dry cough; mucous excretions; pulse little accelerated; nights more painful than the days;

days; slow progress of all the symptoms; insensible termination towards the end of the third; fourth, or fifth week. *Mucous fever.*

These three sorts of fever, established only by abstraction, and which nature rarely exhibits in that state of simplicity, constitute three principal kinds, which have distinct characters, and to which may be easily referred the numerous varieties of simple remittent fever. All the varieties of this form of disease are scarcely ever mortal, and are cured spontaneously at the end of a limited time.

Remittent fevers, like most other affections, may be often prevented or checked at their commencement; but, in general, they ought to be respected in their progress, which seems to be the slow method employed by the organization to restore the deranged order of the functions. The medicines and powerful topics employed with so much profusion during the progress of febrile symptoms, are for the most part very prejudicial.

When a remittent fever has made its attack completely, it requires the expectant mode of treatment, and will not admit the application of any means but such as are proper for favouring its natural progress.

Simple remittent fevers, which are not cured spontaneously, are slowly changed into chronic affections, or assume the pernicious remittent form, of which we are now about to speak.



206. Men who inhabit a salubrious country, who take sufficient exercise, and who are properly lodged, clothed, and fed, are rarely attacked by fever. That which takes place, approaches more or less to one of the three types we have indicated, according to the constitution of the individual, the state of the atmosphere, &c.; and is never mortal. But in very populous cities, where amidst poverty on the one hand, and opulence on the other, a great many individuals are enervated by excessive fatigue, want of food, or food of a bad quality, or by habitual idleness, and excess of too succulent nourishment; when the persons debilitated by these causes, or in consequence of a constitution naturally feeble, of melancholy mental affections, &c. are attacked by a simple remittent fever, it is not uncommon to see it assume the *pernicious* form. This form is characterized by a weakened state of the functions of the senses; prostration of muscular strength; loss of tone in all the tissues; an air of intoxication and stupor, delirium, &c. It generally terminates by the return of health, or by death at the end of the second, third, or fourth week. (*Adynamic fever. Putrid fever.*)

This fever is attended sometimes with great derangement in the whole nervous action; the functions of the various systems of organs are sometimes exalted, and sometimes almost annihilated. All

the symptoms of the disease exhibit anomalies and sudden changes. (*Ataxic fever. Malignant fever.*)

Pernicious remittent, like simple fevers, may be prevented on their approach, or checked after their attack, by all those means capable of producing a strong shock, or a powerful and continued distraction. But when their progress is once completely established, they ought to be respected. All the active remedies, so often employed, are almost always fatal: it will only be proper to maintain the strength by some varied or tonic stimulants, in order that the disease may speedily arrive at its termination.

The cause which most effectually contributes to produce remittent pernicious fever is the exhalation of vegetable or animal matters in a state of putrefaction, especially in debilitated and enervated persons, or persons of a weak constitution. When this cause is very extensive, and has exercised its action on a great number of individuals, it renders the disease epidemic. In this case, the miasmata disengaged from the surface, or from the interior part of the bodies of the sick, reduced to a state of extreme weakness, become a new and very powerful cause of propagation; and the fever, which at first was only epidemic, at length becomes contagious.

In countries where the population is very great, or where men are subjected to forced labour, by  
ignorance

ignorance and despotism, and often under a scorching atmosphere, or amidst continual dampness; these beings, who have food of a bad quality, or insufficient in quantity, without alcoholized beverage, who are badly clothed, and who reside in gloomy, damp, and confined huts, often in the neighbourhood of vegetable or animal substances in a state of putrefaction, acquire a disposition highly favourable for the development of this disease. It is observed that it manifests itself more particularly in consequence of this warm, damp temperature, in which the body remains without strength and without energy.

When it has given birth to a certain number of pernicious fevers, they are then rapidly multiplied by the exhalations which proceed from the diseased bodies.

These miasmata, when received into the lungs of the surrounding persons, produce in them an attack of the same disease, with the more facility as they are more disposed to receive it; and thus favour the progress of the contagion, which spreads with alarming rapidity.

In the course of this fever, the vital forces are weakened to such a degree that the body seems to resist only in an imperfect manner the laws of chemical affinity; and it indeed shows some signs of decomposition differently modified by a remnant of vital action. In this point of view, the  
phænomena

phænomena which take place in the whole organization may be compared to those which occur in a gangrened limb.

Pernicious fever, though at all times essentially the same, exhibits very distinct characters, according to the climate where it takes place, the disposition of the individuals whom it affects, the insalubrity of the countries, the severity of the symptoms, the greater or less rapidity of their progress, &c. which produces differences observed in the different forms denoted under the names of the *jail* or *hospital fever*, *yellow fever*, and *plague*. These diseases, essentially the same, differ only by symptoms of little importance, and by comparable degrees of intensity. The history of the different pestilential epidemiæ, and a more exact knowledge of the nature of this disease, show that the plague cannot develop itself spontaneously, but in cities the wretched, ignorant and superstitious inhabitants of which are confined in damp, gloomy habitations, a prey to poverty and dirt; such as the inhabitants of some countries of Asia, Africa, and America. It may show itself, also, in any country after famine, in towns in a state of siege, overcrowded hospitals, &c.

The chemical composition of the miasmata exhaled by pulmonary and cutaneous perspiration, and by the other excretions of bodies affected



with this kind of fever, is still unknown; but it is not probable that these miasmata can communicate the disease by their contact with the skin; nor does it appear that they remain long fixed to articles which have been used by the infected; on the contrary, they seem to evaporate with the greatest facility.

If the miasmata of the plague could easily remain attached to different articles, and be conveyed from one place to another, which is far from being proved, it is probable that they might be exposed, without danger, among civilized people, who can procure by easy labour the necessities and comforts of life.

The spontaneous development of the epidemias of the jail fever, the yellow fever, and plague, which have taken place at different periods in various countries of Europe, may be more easily conceived than the transportation from distant regions of a specific virus, capable of producing them.

But there is no need of supposing this transportation, since it is evident that the development of a pernicious fever has taken place under a variety of circumstances. This fever may then assume a very high degree of intensity, by spreading itself to individuals weakened by every debilitating cause. The miasmata which then arise from these bodies,



bodies, enervated by wretchedness and disease, exhibit a character highly contagious, and propagate the fever with great rapidity.

When the plague begins then to make a rapid progress in countries where it does not frequently occur, a general consternation prevails; and the dread of an evil, considered as unavoidable and mortal, disposes the body for receiving the contagion, and occasions more ravage than the disease.

It results from these considerations, that the surest and speediest means of checking the contagion of an epidemic fever, which becomes infectious by the lungs, is to remove the sick immediately from the city, and to place them under tents, where there is a free circulation of air, that the contagious exhalations may evaporate with more facility, and be prevented from infecting those in the neighbourhood. These considerations lead us also to some reflections on quarantine and lazarettoes.

These establishments and institutions were formed at a period when there was just reason for being alarmed by a horrid disease, the cause of which was unknown, and with the progress of which physicians were very little acquainted, in consequence of the imperfect knowledge they had at that time acquired of the organization. It was therefore natural that people should search

for and employ such means as were thought proper for preventing a disease, which they believed must necessarily be brought from places where it frequently appeared, to others where it was rarely found. But it is very probable that such precautions are entirely useless in regard to the object proposed; and that they would be rendered so by the manner in which they are employed, even if what is apprehended could take place: that is to say, if the principles of the plague were capable of adhering to merchandise, and of being thus preserved for a long time in bales, in order to be afterwards communicated by contact.

The government which, by exact experiments, which at present may be easily made, shall clear up the question respecting contagion, and by these means convince the most incredulous and most timid, that no danger of this kind is to be apprehended, will be freed from a very great restraint, and may give new vigour to its commerce.

207. Intermittent fever exhibits different types, according to the intervals by which the different paroxysms are separated. The paroxysms return periodically at the commencement of the second, third, or fourth day, and furnish the quotidian, tertian, and quartan types.

Physicians have observed, that tertian fever takes place under the same circumstances which  
produce

produce bilious fever, and in individuals who are most subject to it, and that quartan or quotidian fever presents a striking analogy with mucous fever; but this relation does not render it necessary that intermittent fevers should be united with the remittent.

Intermittent fevers seem to be composed of as many short diseases as there are paroxysms. They may be checked at the commencement of each paroxysm, and thus suffer much better hold to be taken of them. It is in these fevers, therefore, that cinchona has been attended with the most decided success.

A paroxysm of fever may be prevented, or impeded, by all those means which are capable of producing in the organization a new mode of energetic action, continued for some time: such as a strong dose of cinchona, opium, or wine, given during the remission, or a little time before the paroxysm; a very strong and acute distraction, &c.

During summer, and in young persons of a strong constitution, these fevers disappear spontaneously after a small number of paroxysms; in persons of a weak constitution, and during the cold damp seasons, they are exceedingly obstinate. When these fevers continue for half a year or a year, they frequently induce chronic affections,

which slowly lead to a state of consumption, that in the end becomes mortal.

Intermittent fever has its pernicious form as well as the continued. Its pernicious character arises from a peculiar and predominant symptom, the continued exacerbation of which produces death at the end of the third, fourth, or fifth paroxysm. It is in this form of fever in particular, described so well by Torti, that it is proper to make an early use of cinchona, to prevent a paroxysm which may become mortal.

Pernicious intermittent fever, as well as pernicious tertian and quartan, is epidemic, when induced by exhalations from marshes dried up too suddenly by the heat. The miasmata which arise from these muddy bottoms, received into the lungs with the atmospheric air, produce on the nerves of that organ an impression which gives rise to the series of febrile phenomena.

The action of these miasmata is more powerful on individuals not accustomed to it, and who are in a weak state of health.

208. Animals are susceptible of experiencing that general derangement of the functions which constitutes fever, with all that series of symptoms which tend to bring back health. The fever, commonly remittent or continued, assumes various forms



forms according to their peculiar organization, and to a thousand other accessory circumstances.

Among animals collected into herds or flocks, as well as among men crowded together, the fever assumes a pernicious character, and becomes epizootic, in consequence of the same general causes of insalubrity. When it has made some progress, the miasmata which evaporate from a great number of diseased animals may in like manner exercise a very striking contagious influence on the lungs of those which, not being yet infected, are much disposed to become so.

The belief that the progress of epizooties could be checked only by a general *slaughter* of the diseased animals must, no doubt, have arisen from ignorance in regard to this disease; to its causes, and to its mode of propagation; and the dread of infection has been carried so far as to produce orders for the destruction of the hides, and of every thing applied to the use of the cattle.

It does not appear that animals experience the disease under the remittent type, with paroxysms which regularly recur; and it is a very singular peculiarity, that neither tertian nor quartan fever is observed among them.

Almost all the diseases of which a short view still remains to be given are owing to the circumstances of civilization. They consist in a



derangement of the nervous action, which may be suspended, weakened, increased, or changed.

Some of these affections are produced by the impresson of foreign causes; but the greater number are the result of a bad use of the different functions. All these *ataxiæ* show themselves, for the most part, without febrile symptoms.

210. The nervous action is suspended, in a great measure, in asphyxia, catalepsy, syncope, and apoplexy, which constitute the comatose affections. *Comata.*

The asphyxiæ arise, for the most part, from gaseous substances, which when introduced into the lungs produce on the nerves of that organ an action still more violent than that of the miasma of the plague; and occasion a general derangement of the nervous action, without leaving any traces of the affection on the organ first attacked. Hence, in large cities, where so many causes of infection are accumulated, the miasmata which arise under certain peculiar circumstances from privies, tombs, common sewers, &c.; the disengagement of carbonic acid gas, which so often takes place in fermentation, combustion, and calcination; the nitrous and ammoniacal, &c. gases, received into the lungs, suddenly produce vertigo, convulsions, fainting, and apparent death, which without speedy assistance soon becomes real.

These

These diseases, which are real poisoning by the lungs, must be distinguished from the asphyxiæ, which take place in consequence of the mere privation of the oxygen of the air; as when one is immersed in a medium in which none of it is contained, and which however exercises no prejudicial action on the organ of respiration: such are the cases of immersion in water, in azotic gas, or in hydrogen gas.

In the last place, asphyxia may be produced by the continued action of cold.

In every case of asphyxia, whether the disease has been produced by the interception of atmospheric air from the lungs; by the inspiration of any gas not proper for respiration, or by that of poisonous vapours; or by the continued action of cold; it is always proper to remove the individuals, as speedily as possible, from the causes of the asphyxiæ, and then to recall the vital action by different stimulants.

In asphyxia, the action of the senses is suspended; respiration and circulation are interrupted, and the body differs from a carcase only by the remains of heat. An individual may sometimes be restored to life after being in this state an hour, and even much more; but after a longer period resuscitation is impossible.

211. It appears that, in some very rare cases, a violent

violent mental affection, a great disappointment, strong indignation, ecstasies and mystic contemplation, and particularly among women, may lead to a state of stupor and complete insensibility, with *permanency in the attitude in which the individuals were when attacked, or in that in which they are placed by others.* It appears that this state may continue twenty-four hours; after which sensation and motion gradually return, as if after sleep, without any remembrance of what took place during the *cataplexy*.

212. The state of syncope, by which the individual is instantaneously deprived of sensation and motion, with a weakness and even complete suspension of respiration and circulation, seems to arise from an interruption of the afflux of blood towards the brain.

This interruption may be produced by a sudden loss of blood in a person while standing; and after all excessive evacuations. It frequently results, also, from a sudden impression capable of weakening or suspending the action of the heart and arteries; which takes place in some individuals debilitated by long disease, and particularly in some women, whose weak and irritable nerves dispose them for being strongly affected by all sudden impressions.

213. Weak-

213. Weakness of the action of the brain seems to produce apoplexy, which varies in its intensity from that announced a long time before, by derangement or palsy of several organs, to that which takes place suddenly, and which strikes like lightning.

Apoplexy frequently takes place in old age, and seems to show itself in preference during cold, damp weather, in individuals who have suffered by excessive labour, and by the privation of the necessaries of life. Under certain circumstances it has appeared epidemic, and in certain places endemial. A disposition to this malady seems to be communicated by generation. It frequently attacks men loaded with obesity; who have a short neck and a large head; who take little exercise, and who habitually indulge in an excess of food.

Apoplexy may be produced also by compression, agitation, and læsion of the encephalic organ.

This disease being for the most part produced by weakness of the cerebral organ, bleeding and evacuations, so frequently employed, are almost always hurtful.

Though the medical art furnishes few resources capable of opposing an affection generally followed by relapses, which at length become mortal, tonics and varied stimulants are the properest means for preventing the return of the disease.

Even



Even if apoplexy were produced by an effusion of blood in the brain, bleeding would still be hurtful, since it could have no effect in regard to the effusion, and would deprive the patient of the strength necessary to produce a resorption of any effused matter.

Bleeding is proper only in those few cases where apoplexy is produced by an afflux of blood towards the head; in some adults of a plethoric habit and strong constitution: in this case it ought to be copious, and speedily employed.

The distinction of apoplexy into sanguine and serous is of no signification. The serous or sanguine effusions, observed sometimes in the cranium, are much rather the effect of the disease than its cause. Most of the other organic alterations which have been found on opening the bodies of persons who died of apoplexy, either in the cranium, the thorax, or the abdomen, are produced by the general causes which conduct slowly to apoplexy.

214. There is no system of organs in which the nervous action may not be interrupted, or weakened, to such a degree as to be deprived of the force necessary for discharging, in a proper manner, the functions assigned to it. This state of *asthenia* varies from slight debility to complete



plete palsy, and exhibits peculiar phænomena according to the organs affected.

In the muscular system; asthenia produces debility, tremor, and palsy; and, according to the parts attacked, St. Vitus's dance, torticollis, aphonia, &c.

In the system of the nerves, the eye exhibits all the intermediate degrees between weakness and palsy of the optic nerve; which according to some peculiar characters gives amblyopia, hemeralopia, nyctalopia, and amaurosis or blindness.

In the ear, the different states of asthenia of the acoustic nerve give various affections of that organ, from dullness of hearing, in a greater or less degree, to complete deafness.

The case may be the same in regard to the senses of smelling, tasting, and touching.

Weakness of the nervous action, in the system of digestion, produces loss of appetite, or anorexia; in the pulmonary organs, difficulty of respiration, or dyspnea and asthma: in the system of generation, this weakness varies from dyspermatismus to impotence or anaphrodisia.

Palsies are always incurable: the weakness requires the aid of varied exciting medicines and tonics, either applied to the organization in general, or to the debilitated part.

215. The nervous action of our organs, independently

pendently of the different states of weakness of which it is susceptible, may contract also a great degree of mobility; it may want proper steadiness, and be habitually exercised only with derangement and disorder. It then gives rise to a series of convulsive affections, sometimes continued, but almost for the most part intermittent, and always subject to periodical returns. These affections generally result from a natural weakness of constitution, a vicious education, and the improper use of the voluntary functions.

This particular state of nervous action produces in the system of circulation and respiration: palpitations of the heart, convulsions of the larynx, cramp of the thorax, convulsive asthma.

In the system of digestion it produces convulsions of the œsophagus, hiccup, vomiting, pains in the stomach (cardialgia); it gives rise to convulsions properly so called, and to tetanus; in the muscular system this mode of derangement appears in the whole of the organization, during paroxysms of madness, epilepsy, and hysterics.

In the last place, derangement of the nervous action produces different disorders which are observed in the intellectual functions. *Vesaniæ.*

Most of the convulsive diseases have been considered as local affections; they however depend, for the most part, on a general derangement, which

which shows itself, in preference, in some particular organs.

It is of importance that we should here describe, with some minuteness, those general causes capable of producing these nervous affections, which are become so frequent in large cities among one class of society. To comprehend these causes, it must always be remembered that health is the result of a proper discharge of the different functions; that these functions must be habitually performed, as if each organ ought to consume a determinate quantity of nervous action, which absolutely requires to be used; that the organs are strengthened by moderate exercise, and weakened by forced exercise and by rest, &c. In a word, it must be remembered that all particular affections are capable of being transmitted, at least in part, by the means of generation.

Thus, in the opulent class, women of a delicate constitution, whose weak and unsteady nervous action renders them subject to what are called nervous affections, experience in general difficult parturition, are subject to frequent miscarriages, and bring forth weak delicate children like themselves.

It is observed, that such children are subject to interruptions in their sleep, subfultus tendinum, and frequent colics; and that their dentition, always difficult, is accompanied with convulsions, &c.

It

It is not advantageous for these children to be suckled by their mothers, who associating them to their manners and habits, supply them with milk which affords little nourishment, and which possesses the irritating character of the products of all the secretions, in a certain state of weakness or disease.

It would be much better if they were sent to the country, and committed into the hands of nurses whose simple manners and mode of life, more agreeable to the laws of the organization, would gradually correct their primitive dangerous dispositions.

But if they remain with their parents, the latter, through a mistaken fondness, never suffer them to be absent from their sight ; they do not allow them a moment of liberty to take that exercise which is necessary for the complete development of their organization. Being always near them, they manifest a continual uneasiness lest their health should be deranged. These children, overloaded with clothes, and particularly on the head, fed in an improper manner, and deprived of exercise, are exposed to frequent colds and often to horrid eruptions. In consequence of an opposite abuse, we often see other children equally delicate and weak, kept habitually naked under a damp, cold temperature, become subject to catarrhal affections, and to rheumatisms exceedingly troublesome.

When



When these children begin to grow up, the parents, who never suffer them to be out of their sight, calculate with scrupulous minuteness the result of every step they make, and of every morsel they eat. They repeat to them a thousand times a day, to take care of their health; that they will be hurt; that they are going to die of hunger, or perish by indigestion. These beings, perpetually stunned in this manner, gradually acquire a habit of fear, and, notwithstanding the pliability of their age, often become weak and pusillanimous.

On the other hand, through a fear of displeasing or vexing them, they are never checked in their extravagant whims; they are suffered to gratify all their caprices, even at the expense of those around them; and they thus acquire a habit of obstinacy and domineering, to which they are all strongly inclined.

Far happier are the children who are not reared under the immediate eye of their parents; nature with less trouble succeeds much better in developing their organs, and in forming their understandings.

In another class of society, among the indigent inhabitants of towns, children are associated, during their earliest years, in the wretchedness of their parents, and the diseases it brings along with it. These children are then educated under a



continual fear of brutal and blind severity, surrounded by vulgar prejudices and the most absurd superstitions.

These two kinds of education, though in appearance diametrically opposite, produce almost the same general results.

As the children here alluded to grow up, and their intellectual powers begin to expand, they are soon compelled to remember things which they do not understand; their minds are occupied with nothing but the wonderful events of history, the absurd fables of mythology, and the mysteries of religion. They are never allowed to think for themselves; and in this manner they are gradually accustomed to believe in things inconceivable and supernatural.

During the first period of youth, children of both sexes receive nearly the same mode of education; but when they begin to approach the age of puberty their situations are changed.

Boys are allowed more liberty, and by proper exercise correct, in some measure, the vicious results of their first education.

In a word, the instruction given to them relates chiefly to literature and the fine arts; they complete their studies without having an idea of the exact sciences; they are unacquainted with the reason of any of the phænomena which daily take place before their eyes, and in their organization;

tion; they remain perfect strangers to every thing around them; spend their lives like blind persons groping their way through surrounding objects, and serve a continual and unfruitful apprenticeship.

These men, however, who are not destined to the mechanical arts, pursue in society different directions, in which it is of importance to follow them.

Those who apply to commerce and business are in a situation where they may enjoy pretty good health, if their occupations oblige them to take proper daily exercise, and if they live with sobriety and temperance; but when they pass the greater part of their lives in the counting-house, or in the closet, and when their principal enjoyments consist in the pleasures of the table, they always at length become subject to some of those nervous affections of which we have already spoken. The slow and continued progress of these diseases induces them to consult all the medical men with whom they are acquainted; and they generally follow the advice of those who give them the most extravagant prescriptions, and thus often render their situation much more dangerous.

Those who pursue a military career in the time of war, lead a kind of life exceedingly proper for producing a strong constitution, provided

they are able to support the first fatigues, and if they live with temperance. Taking frequent and strong exercise, by which all the faculties may be expanded; living alternately in different climates; using all kinds of food; sleeping often under tents or in the open air; and having no fixed hours for repose or for meals; they are subject to no habits, and give to their organs all that strength of which they are susceptible.

This mode of life approaches very near to that of people in the hunter state; who have always exhibited a very striking superiority of organization.

Those who devote themselves to literature and the fine arts are exposed to nearly the same kind of life as merchants, or persons in office, and, like them, are subject to the same affections; for the cure of which they are often seen to employ the most improper means, while they neglect the most simple and salutary.

It is very astonishing, that those who produce the most admirable works in the imitative arts should be entirely strangers to the principles of philosophy, and often slaves to the most ridiculous prejudices.

Among such persons, we often find some whose luxuriant imaginations are always producing a whimsical mixture of ingenious fictions and agreeable chimeras, embellished by the beauties of  
diction.

dition. These amiable fools are received and encouraged by the numerous class of the idle and ignorant, whom nothing pleases so much as the wildest flights of the imagination, which they consider as the strongest marks of genius.

In the last place, there is a small class of idle persons, who, through a defect in their early education, are left in a situation still more disagreeable; they are gloomy, restless, and continually occupied with the feeble state of their health; a prey to melancholy mental affections: in this manner they languish for a long time, and at length become hypochondriac.

These unfortunate consequences of a bad early education seem to have been felt only in a very slight manner; and it appears that the question, What is the best education? remains still to be solved, for want of having been properly proposed.

The object of the first education ought to be to produce that development which is best suited to the whole of the functions, and to teach those things which may be of the greatest utility throughout life to the majority of citizens of the different classes.

Thus, with the study of one's mother tongue and of the mathematics, a knowledge of natural philosophy, chemistry, and physiology, ought to form the basis of every good education.



During education, care should be taken, by varied exercises, to favour, in a proper proportion, the development and strength of the muscular system, of the organs of the senses, and of the intellectual functions; and it ought never to be forgotten that the predominance of a function always takes place at the expense of some of the rest.

It will be proper in the different exercises, as well as in regard to meals and to sleep, to avoid that daily regularity which, in the course of time, renders men similar to those machines which can be kept in motion only by winding them up every day, at the same hour, and in the same manner.

The best habit to be contracted is that of having none. The empire of habit disposes people for being affected by every change and by all sudden variations; it likewise becomes an obstacle to new discoveries, by confining those subjects to its influence to the common hackneyed path.

216. Young women, in the opulent class of society, have often fewer opportunities of escaping from the baneful influence of a mistaken education: in general, they are under much greater restraint than boys, and cannot so easily indulge in that exercise which their age requires. The chief part of their attention is turned to the or-



namental parts of education ; they insensibly acquire a habit of indolence, and at length are reduced to such a state that it is impossible for them to be active. Their weak and delicate organs acquire a high degree of irritability, and become exceedingly sensible to the slightest impressions. Some of them, even in their earliest youth, feel the consequences of this kind of life : they are subject to frequent indisposition, to slight nervous affections, to frequent irregularities in the exercise of their different functions. These individuals, however, seem to enjoy good health ; have a fresh complexion, display personal graces and talents ; possess great liveliness, and seem to unite all those qualities which are calculated to please : but, in general, they resemble plants cultivated at great expense in hot-houses : they often exhibit the same glowing colours as those which grow in the natural state ; but they have neither the same vigour nor the same perfume.

The existence, in some measure artificial, of a great number of these women, who have acquired a habit of living in a state of the most complete idleness, is a circumstance exceedingly curious in physiology. If their situation be minutely examined, even at a time when they do not appear to be in bad health, it will be found that the greater part of their functions are reduced to a

minimum of action, and that some of them exhibit wonderful alternations of extraordinary debility and exertion. Thus the muscular system, which is incapable of habitually enduring very gentle and continued exercise, is capable of overcoming the greatest efforts in paroxysms of hysterics. The intellectual organ appears to be exceedingly delicate; it can speedily give birth to the most ingenious fallies and repartees; but the attention cannot long remain fixed to the same object. The organs of the senses, possessing great irritability, are disagreeably affected by all violent impressions; by hideous forms, strong odours, a harsh sound, or the slightest touch. All sudden and unusual sensations produce syncope, or other nervous affections exceedingly dangerous.

Such females have scarcely any appetite; they take very little food, and prefer highly seasoned aliments destitute of nourishment. In a word, they are subject to habitual costiveness; the urine is scarce, pellucid, and often inodorous; perspiration is hardly sensible; the skin is cool and pale, and either void of odour, or emits a very peculiar one; respiration is short; the pulse is slow or accelerated, but habitually weak. The desire of venery is either annihilated or transient; there exists, for the most part, a habitual leucorrhœa, &c. &c.

If

If this state be compared with that of a young female whose organs have acquired proper expansion, a difference so great will be observed, that it will scarcely be possible to conceive how the physical faculties, among the former, could be reduced to a permanent state of debility so near a-kin to death.

The varied derangements, produced by the want of occupation, or the bad direction of the nervous power in general, have been very frequent, especially among the female sex, at a period not very remote, when the numerous class of the nobility, and those devoted to monastic seclusion, were condemned, by their situations, to a state of indolence, and when a sort of infamy was attached to business. This ridiculous prejudice induced a great number of individuals to expose themselves to great toil and labour during a part of their lives, in order to acquire speedily, with opulence, the noble privilege of slowly perishing by languor, disease, and consumption.

It was among this class of the rich and the indolent that the most complete abuse of all the organic functions was observed.

Hence the muscular system, which so imperiously requires that its functions should be exercised, is condemned to absolute rest in individuals who do not even take the trouble to walk.

The

The table, decked out with profusion, presents highly succulent food, proper for repairing the losses they have not sustained. Spiceries, which ought to be united only with substances difficult of digestion, are combined with the extracts of nutritive parts; and yet these stimulants become necessary for exciting the enfeebled organs, and for procuring a few new sensations.

The stomach, thus stimulated beyond measure, receives useless aliment, on which it exercises a continual and laborious effort; while all these disorders are increased by the abuse of generous wines and of spiritous liquors.

In some, the organ of reproduction is incessantly stimulated by all the means which nature or art can supply; and an immoderate use is made of it, which tends speedily to consume life: in others, a continence determined by civil or religious considerations is engaged in a continual struggle with all those means which are calculated to excite venereal desires.

In a great many, the intellectual organ is continually disordered by different passions, and by the arts of imitation or of the imagination. In this state it may acquire an immoderate exaltation, approaching near to madness, when not checked by a sense of social duty, and by the present boundary of human knowledge in the exact sciences.

It



It needs excite no astonishment, that so depraved a use of the most important of all the functions should in the course of time produce so great derangements.

These nervous affections, a part of which are commonly distinguished by the vulgar appellation of the *vapours*, have by many been considered as merely imaginary \*, because they often occur in individuals who exhibit every appearance of being in perfect health. They however constitute very painful diseases, which at first exist without any organic alterations; but which at length give rise to changes of this kind, and thus become combined with the affections which they produce.

Nervous affections, in general, attack persons only whose intellectual functions are kept in an habitual state of activity; which supposes the continued action of the different organs of the senses, since the intellectual organ can combine only sensations which have been received.

Continual and almost exclusive exercise of the organs of the senses, and of the intellectual functions, tends to raise them to the highest degree of improvement; but the other systems of functions, and particularly those of motion and diges-

\* Young females, either from a desire of being fashionable, or of attracting more notice, have been seen to imitate all the manners of those really affected with hysterics, and by these means become much sooner hysterical.



tion, if not subjected to proper exercise, become weakened; and as all the organic systems are connected, and have a mutual dependence on each other, it thence follows that as these organs are weakened and deranged, the organs which receive the sensations, and that which combines them, are deranged in the same ratio, and at length become incapable of performing their functions with that regularity which they must acquire by long and continual exercise.

On the other hand, men who live in a continual state of apathy, without curiosity, without fear, and without ambition; who make only a very limited use of the organs of sense and of the intellectual functions; who place their whole enjoyment in the pleasures of the table, and in intercourse with the female sex, are not subject to these affections; and may spend the greater part of their lives in a state of inactivity without any bad consequence to the organization: exercise of the organ of generation is that which supplies, with most advantage, a deficiency of employment to the organs of loco-motion. When such men have a strong gastric system, and employ a great part of their time in digesting properly, by leading in the lap of abundance a life merely vegetative, they generally become loaded with flesh, which is attended with all the inconveniences peculiar to obesity.

During

During the course of the French revolution, numerous examples occurred, which evidently prove that all this order of diseases was merely the result of that idleness which prevails amidst opulence and luxury; and that exercise, useful occupation, and a temperate life, are sufficient to check its progress, and to bring back health. Among the persons crushed amidst that national shock were a great many debilitated females habitually subject to disease: these indolent females, compelled to fly, to take exercise, to attend to the care of their existence and to their safety, and who were even constrained to begin to work that they might procure the necessaries of life, acquired in this active and laborious state strength and energy, and ceased to be a prey to nervous affections.

It was from this order of diseases that physicians derived the greatest benefit: those in vogue maintained their carriages by the nervous affections of the opulent.

It was also by this order of diseases that *the art of writing prescriptions*, which had become almost entirely the whole art of medicine, was most exercised and improved. To be daily obliged to see patients, who constantly recited the highly varied series of the symptoms of the same affection, and at each visit to prescribe something which should have the appearance of novelty, and which, at the  
same

same time, should afford a certain degree of relief, was a task which required a considerable share of sagacity. The prescriptions, however, for the respect paid to them were indebted to the strange language in which they were written, and to the characters which rendered them unintelligible.

END OF THE SECOND PART.

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PART

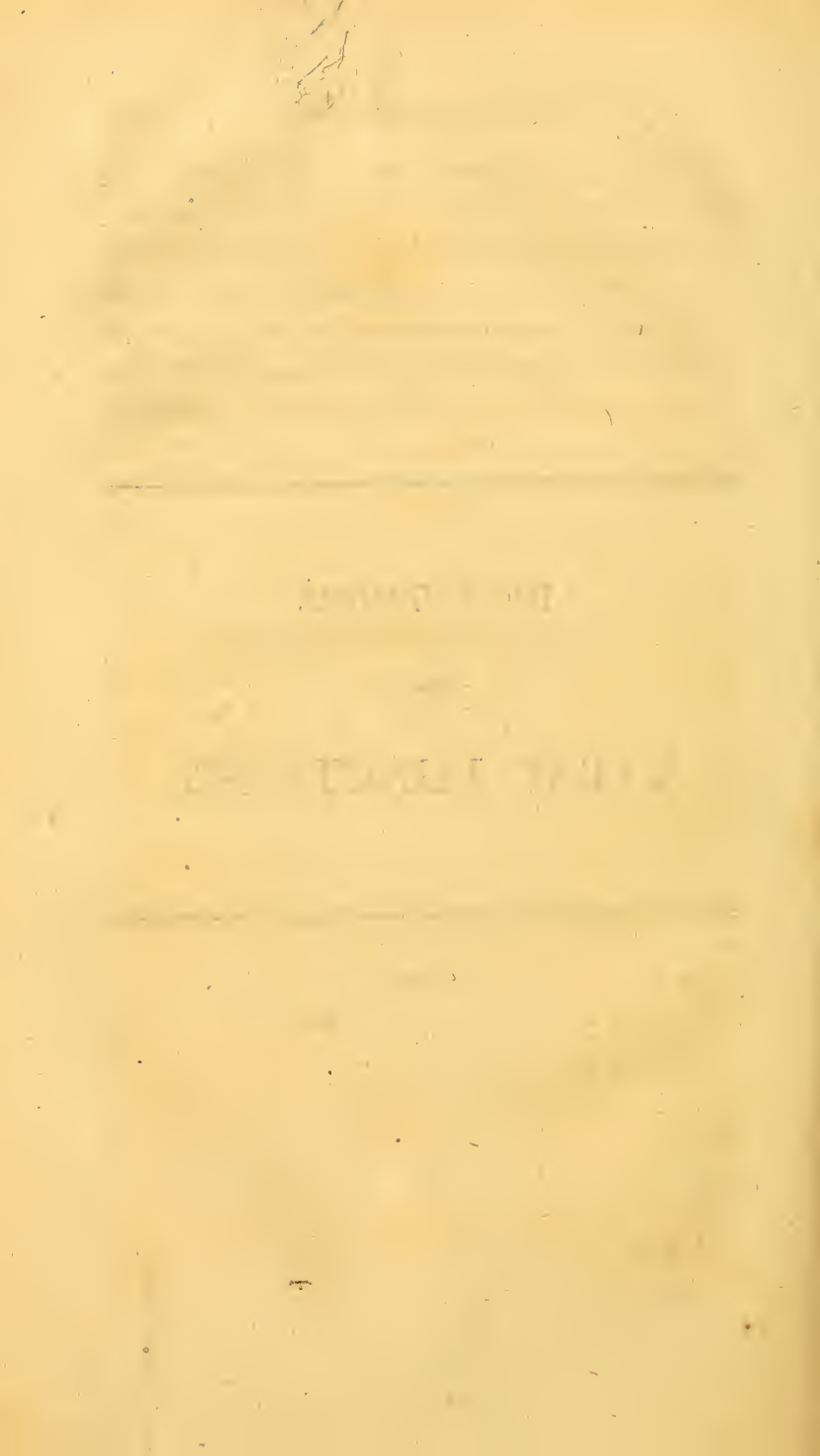
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## PART THIRD.

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# VITAL FUNCTIONS.

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# VITAL FUNCTIONS.

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## ACTION OF THE BRAIN AND OF THE NERVES.

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1. WE have examined the material structure of the systems of the different functions, in organized beings in general, and in man in particular, giving a detailed description of the forms, relation, and uses of the different parts of which they consist, and we have added various physical observations, with the result of the chemical analysis made of them.

We have also given a history of the derangements to which the different anatomical systems of organs, the various functions, and the organization in general, are subject. It therefore remains that we should exhibit a view of the vital phænomena, in the organization in general, and consider the peculiar functions and reciprocal action of each system of organs.

2. In taking a general survey of the whole organization, we every where observe vessels and

nerves in such quantity, that it appears that the whole organic structure is composed of only two orders of parts, which by their different intersections form numerous tissues. In the cells or areolæ of all these tissues are deposited the albuminous, gelatinous, adipose, saline, &c. juices, of which the vessels and nerves themselves are composed.

The vessels form almost the whole of the tissues; they convey the materials intended to serve for the nutrition of all the parts, and carry back the residue of all the secretions. The nerves distribute the principle of action to every part, so that the heart and the brain, the principal centres of these parts, are evidently the most important organs. The cerebral system and the nerves ought, however, to be considered as the organs most essential to life; since they distribute the principal action to every part of the body.

It results from these principles, that the different systems of organs which essentially consist of tissues, formed by the vessels, may be considered, in general, as instruments; and the nerves which are distributed thither as the power which puts them into action.

We shall first consider the general power of the organ which communicates motion; and then examine the action of the different instruments which it puts in motion.

3. The cerebral and nervous system are essentially composed of the encephalon, the rachidian prolongation, the trisplanchnic, and the nerves which are continued with these parts, and which are distributed to all the organs.

The perfectibility of the cerebral organ seems to depend on the size of the encephalon, and on the tenuity of the nerves. We observe, indeed, that the encephalon of man is proportionally larger than that of other animals; and that his nerves are smaller and more numerous. The size of the surface of the brain is increased by its numerous and profound anfractuosities. The different sections made in that organ exhibit a great many eminences, cavities, and strata of various forms and colours, with the uses of which we are unacquainted, but which are evidently more numerous than in that of other animals. In a word, it is observed that the cerebrum, the cerebellum, and the mesencephalon of man are less distinct, and seem to be more confounded, than those of other animals.

The encephalon is not a pulpy mass, and every thing seems to give us reason to believe that it is a very important organ of secretion: It is indeed observed that it receives about a sixth part of the blood, which is conveyed from the lungs by a very short passage; the cerebral arte-

ries are uncovered, that is to say, have no cellular tunics; they exhibit frequent anastomoses; are indefinitely ramified over the large surface of the brain, then enter the interior part of it, and immediately disappear.

It is not improbable that these arteries, by their indefinite division, are soon changed into serous vessels exceedingly small. The blood then returns from the encephalon by numerous tortuous veins, which deposit it at certain intervals in sinuses, where it remains for a longer or shorter period.

The encephalon gives birth to twelve pairs of nerves, which are distributed to the face, to the cranium, to the neck, to the breast, and as far as the stomach. Of these nerves the optic and the ethmoidal arise from the brain, and the rest from the mesencephalon: none are furnished by the cerebellum.

The rachidian prolongation gives thirty pairs of nerves, which issue through the vertebral holes, and are distributed to the neighbouring parts.

The trisplanchnic gives birth to the nerves which are essentially distributed to the organs of circulation, of digestion, and of respiration. The encephalic and rachidian nerves form, by their union, the nerves of the limbs.

In the last place, the nerves of all the parts have a communication with each other, and with

with the encephalon, in a manner more or less direct.

This short view, though very incomplete, is sufficient to show by analogy, that the brain must perform a very important function, since it is furnished with every thing necessary for the most perfect organ of secretion; that its secretion must be effected by means of vessels so fine, that the long capillary canal of the testicle exhibits only a very coarse model of them, and that the result of this secretion must be a fluid exceedingly rare.

These few observations, respecting the anatomical structure and distribution of the cerebral and nervous organ, though not sufficiently satisfactory, may serve, when united to accurate observation of the phenomena of life, to give a pretty extensive idea of the function which it performs.

4. Every part of the organization consists of a tissue of vessels and nerves, in the interstices of which are deposited liquid or solid substances of different natures; and under this point of view they may be considered as so many organs of secretion and excretion. The *moleculæ* of matter which enter into their composition are continually dissipated, and their place is supplied by others which insensibly assume a peculiar arrangement. During this process, the organic and living part



always loses, by the inert matter deposited in these interstices, so that at length the latter impedes the vital action, the organ then dies, and becomes subject to the empire of general affinity.

This vegetative or animal life, peculiar to every part of the organization, is performed by means of vessels which convey to them the materials of nutrition, and carry back the products of the secretions. The action of the vessels is maintained by the presence of the nerves which accompany them, and which proceed in a particular manner from the trisplanchnic. Such seems to be the general mode of the vitality of a great number of vegetables and animals, each part of which is endowed with its own peculiar kind of life, without forming a necessary and constituent part of a whole, and may separately procure to itself the materials of its nutrition. These beings are susceptible of division, and are easily reproduced from slips.

But in bodies of a more compound organization, and particularly in man, each living part forms a portion of the whole, and contributes to the formation of the different *systems of organs*.

The systems of organs perform the functions peculiar to them, by means of particular nerves, and thus enjoy a new life. This *organic life* is that which is of the greatest importance. Thus a muscle is composed of a tissue of vessels, which has its

its proper life of nutrition. These vessels, by their contexture, form bundles of fibres susceptible of contraction ; and this contraction is performed by means of particular nerves. If these nerves are cut, contraction no longer takes place ; but the muscle continues to live.

The nerves which give vitality to the vessels are furnished to them by the trisplanchnic : these nerves expand in the abdomen, over the principal trunks, and accompany them in all their divisions and subdivisions. The vessels then can no longer be separated from the nerves ; and carry every where with them their principle of action.

The nerves distributed to the different systems of the organs come from the encephalon, or its rachidian prolongation, in large trunks susceptible of accidents, and on which experiments can be made.

It has indeed been observed, that as soon as a nerve has been cut, or a ligature has been formed on it, the function of the organ to which it is distributed immediately ceases.

A nerve which has been cut is capable of cicatrizing like other parts, and of gradually resuming its action\*.

If the muscles of an animal, recently killed, be

\* See Haighton's experiments on this subject in the Transactions of the Royal Society of London for 1795.

irritated by the point of a scalpel, they contract for a longer or shorter time, and then cease to move: if they be suffered to remain at rest during a certain period, and be then irritated, they again contract, but in a weaker manner, and at length cease to be affected by the point of the instrument: but if excited by any other irritant, such as the Galvanic fluid, by making them form part of a Galvanic chain, they are once more seen to exhibit contractions: but at last they become entirely motionless.

It would appear from this series of phænomena, which the muscles exhibit while irritated, that irritation makes them gradually lose something, which at length becomes completely exhausted.

It is observed, in animals, that the contraction is in general more sensible, as death has been speedier; and there is no contraction when they die slowly after long sufferings or violent convulsions, during which the nervous action has been completely exhausted.

5. The regular and simultaneous exercise of the action peculiar to each tissue (*animal life*), and of the action peculiar to the different systems of organs, which form these tissues (*organic life*), constitute life and health.

It appears *as if* the cerebral system, in the exercise of its functions, *secreted* a fluid analogous to the electric fluid; *as if it distributed* this fluid

to

to every part of the body, by means of the nerves, which serve it as conductors ; and *as if it* communicated to this fluid a peculiar movement, in consequence of which each organ performs the function assigned to it.

The hypothesis of a nervous fluid, though highly probable, and as we may say necessary, ought to be considered only as a convenient method of explaining facts which cannot be disputed:

In the exercise of its function, each organ seems to draw off, and to consume a part of this fluid.

This fluid, destined to be employed in an uniform manner by all the systems of organs, may be employed by the forced exercise of one : in this case, the rest, without having been exposed to any exercise, are reduced to a state of instantaneous lassitude.

The nervous fluid, consumed during the exercise of the functions, is repaired by rest.

The nervous fluid, which is secreted, absolutely requires to be employed : when not habitually consumed, its reaction produces, in the different organs, derangements more or less serious.

The impression made on the organs by the contact of foreign substances produces a change of action, more or less striking, according to the nature of these substances, and the structure of the organ which has been touched.

The impression received gives to the nervous  
fluid

fluid of the part a movement; which is propagated as far as the brain : the action of the latter is then augmented or changed.

The movement of the reaction of the brain is immediately transmitted to the part which has received the impression, or to any other particular organ, or to the whole of the organization, and produces varied phænomena.

When the natural action of the parts is properly stimulated, a sensation of *ease* is the result ; and when the functions are deranged a sensation of *pain* is experienced.

This sensation appears always to be the result of a reaction of the encephalic organ.

The phænomena of life are maintained by the presence of different natural stimulants, such as heat, the air, food, &c. These substances, by stimulating the nervous action of the organs, supply them with the materials necessary for the exercise of their functions.

When an organ has been subjected to the action of a stimulant, the result may be two phænomena very distinct : 1st. The part performs, in a manner more or less apparent, the function peculiar to it : 2d. The individual is conscious of the impression received.

Every organ which is stimulated tends to perform the function peculiar to it.

When the different organs of an animal, recently



cently killed, are irritated by a powerful stimulant, each of them receives the impression, and answers to it, according to its own manner. When the irritated organ, in consequence of the relation between its parts being destroyed, cannot discharge the function for which it is destined, it always receives the impression, and the latter is then transmitted to distant organs, where it may become apparent.

The organic system, on which the action of stimulants is exhibited in the most evident manner, is that of the muscles, because its function is to produce motion.

If an animal, recently killed, be placed in such a situation that its different organs are interposed in the chain of a strong Galvanic pile, the muscles become convulsed, the bladder contracts, the intestines perform a sort of peristaltic motion, the motion of the heart is accelerated, &c. In organs which cannot execute the function peculiar to them, or which perform that function without any apparent motion, such as the liver, the spleen, the kidneys, the ovaria, the matrix, &c. the impression is also received, and when strong is transmitted to the muscles of the pelvian limbs, which, in this case, are violently contracted. These general truths are sufficient to enable us to form a just estimation of every thing that has been said on the subject of irritability,

*Consciousness*

*Consciousness* of the impression received, or sensation, appears, as already said, to be the result of a reaction of the cerebral system. Hence, when the natural relation is not interrupted, and when an organ is stimulated, the impression is transmitted to this system of organs; and according as the movement of reaction is regular, or as it is performed with trouble and disorder, the individual experiences a state of ease or of pain. These observations may serve to account for the numerous phænomena of *sensibility*.

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## ACTION OF THE BONES.

6. THE solid support of the body is formed by the bones, the arrangement of which determines the form of the individual, in the structure of the skeleton.

The skeleton is essentially formed by the trunk and the limbs. The trunk is composed of three distinct parts, the thorax, the head, and the pelvis: these three parts are united by the vertebral column.

The thorax contains the principal organ of circulation and those of respiration; the head contains the cerebral organ, which is continued along the rachidian cavity; and the pelvis receives or supports the principal organs of digestion and those of gestation. The bones of the limbs, as well as those of the trunk, afford points to which the muscles destined to move them are attached.

7. The different pieces of the skeleton are united different ways: some are fitted into each other by indentations; others are united by plane surfaces; but the greater number are articulated by smooth, round, and excavated surfaces.

In

In these different modes of connection, the surfaces are sometimes covered only by a thin membrane, as in the bones of the cranium, some bones of the face, and the teeth. For the most part, they are incrusted by a cartilaginous substance of greater or less thickness, and exceedingly elastic; as is the case with all the moveable articulations: in the last place, a cartilaginous plate is found between the articular surfaces of the bones of the shoulder, of the knee, of the jaw, &c.

The bones joined by indentations or by plane surfaces, without cartilaginous incrustation, are entirely motionless; others perform movements, which vary from the very obscure motion of the bones of the pelvis, of the vertebral column, of the tarsus and metatarsus, to the very extensive movements, in all directions, performed by the bones of the arm on the shoulder.

The moveable articular surfaces are enveloped by a membranous capsule, and secured by means of ligaments.

The articular and capsular surfaces secrete a viscid albuminous liquor (*synovia*), which renders the motion softer and easier. This liquid is taken up by the absorbing vessels, and is continually renewed.

The secretion and absorption of this liquid are maintained

maintained and excited by motion : perfect and long continued repose produces, at length, an ancylosis.

8. The system of the bones is composed of the bones properly so called, the membrane by which they are enveloped, and the marrow contained in their cavity.

The half of the mass of the bones is composed of vessels, nerves, gelatine, fibrous matter, &c. The vessels, by their intersection, form cells or areolæ, in which the hard part is deposited.

The marrow is composed of a vascular and membranous reticulation, the vacuities of which are filled by a greasy and albuminous fluid.

The vessels and the nerves which proceed from the periosteum, and those which traverse that membrane, penetrate into the substance of the bones, and are continued with the vessels of that part, those of the interior periosteum, and those of the marrow.

The organic and living part is composed of the aggregate of all these vessels and nerves ; and the phenomena of ossification result from the circulation, the secretion and absorption which they continually exercise.

The hard part of the bones is composed of phosphate and carbonate of lime : the latter salt is in the proportion of a tenth.



The gelatinous or albuminous bones in the germ, pass like all the other parts to the fibrous or filamentous state in the embryo, and become cartilaginous in the foetus.

The cartilaginous substance gradually disappears during the last months of gestation, and during the first year of life, to give place to the saline matter, from which the bones derive their solidity.

The cartilaginous or osseous state begins by points, like a kind of nuclei, around which are accumulated *moleculæ* of the same nature : these cartilaginous or osseous points, by increasing, reach each other, unite, and are at length confounded.

There are three points of ossification for the long bones ; one, and frequently several, for the short bones.

9. The bones when they become solid do not remain in that state : the *moleculæ* of the phosphate and carbonate of lime, or their elementary parts, are continually dissipated, and replaced by others, which always assume a different arrangement ; and in the course of this process the accumulation of calcareous salts encroaches on the vascular tissue of the bones.

It is indeed observed, in infancy, that the bones are reddish and pretty flexible ; at the adult age they

they become more compact, and assume a bluish colour; in old age they are dry and brittle, and exhibit a yellow ash colour.

If an animal, the bones of which are still in a state of growth, be fed for some time on madder, the bones become covered with a rose-coloured stratum on the outside; if the use of this food be afterwards suspended, they become covered with a new white stratum, and the rose-coloured stratum is more and more covered in the course of years.

On the other hand, it is observed, that the cavities of the long bones increase in size as the individual grows older.

It has hence been supposed that there is reason to conclude, that bones which increase in length and in breadth by development, increase also in thickness by concentric strata on the outside, and that the long bones are destroyed in like manner by concentric strata in the inside of their cavities, which consequently increase in size.

10. In the phænomenon of the coloration of the bones by madder, we must not imagine that the coloured moleculæ of that plant are deposited on the bones to give them a rose colour; nor must we believe it to be absolutely necessary that these moleculæ should be conveyed to the bones to change their habitual mode of action.

Foreign substances do not circulate in this manner in the organization ; and those bodies supposed to be susceptible of penetrating thither so easily, are not found in the different parts.

The action of the madder on the digestive organs produces a mode of action, particularly remarkable, in the secretion of the osseous substance, and even in the secretion of milk ; but the chyle which ought to be the natural medium for conveying the madder into the mass of the blood, and thence into the bones or the udder, assumes no colour by the use of this root.

II. The bones become displaced, or are subject to luxation, with greater or less facility, according to the nature of their articulation.

A knowledge of the relation of the articular surfaces and of the soft parts by which they are surrounded, is sufficient to determine in what direction luxations may take place : they are sufficient also to determine the forces proper for reducing them.

Luxations are reduced with greater ease the more recent they are : they may however be reduced even when of long standing, but with much more difficulty.

When a bone remains in a state of luxation, the pressure and motion of its head give rise sometimes to the formation of a new articular capsule,

capsule, at the expense of the neighbouring soft parts, which in the course of time assumes a cartilaginous and even osseous texture: in this manner there is formed a new articulation, which admits only of very confined movements.

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## ACTION OF THE MUSCLES.

12. **T**HE muscles are formed of fibres in bundles: each fibre is composed of several small fibres, and the small fibres are subdivided into others still more minute. This indefinite subdivision, the termination of which cannot be perceived by the best instruments, renders it impossible for us to know what the nature of a simple fibre is.

The muscles, the bundles of fibres, the fibres and small fibres, are separated by a covering of cellular tissue, in which are accumulated those albuminous, gelatinous, and adipose juices, a greater or smaller quantity of which constitutes the state of leanness or fatness.

The muscular fibres, when stripped of all their coverings, exhibit, in their decomposition, a great deal of gluten or fibrous matter, a substance found only in the red part of the blood.

The muscles are of a reddish colour, and are terminated towards the point where they are attached by a very close fibrous tissue, of an enamel white colour, exceedingly elastic, much less voluminous than the body of the muscle, and which assumes the form of cords or bands.

These



These white fibrous parts, which constitute the tendons and the aponeuroses, are essentially formed of gelatinous substance; and by decomposition they do not furnish gluten.

13. When a muscle is irritated, its fibres become shortened, contract, carry with them the moveable points to which they are attached, and thus produce the different motions.

The muscles begin to contract in the first periods of life, by the irresistible tendency to motion which is experienced in the different states of uneasiness, or of want; but they gradually assume the habit of a more regular exercise, and their being kept in continual use gradually develops that force, pliability and dexterity of motion to which they are capable of attaining.

The force of the muscles, in general, is in the ratio of their thickness and of the length of their fibres.

The muscles, for the most part, act in a very unfavourable manner; they have a direction almost parallel to that of the limbs; they are attached very near to the centres of the articulations, and their power being frequently placed between the point of support and the resistance, they form a lever of the most disadvantageous kind.

The ordinary force of the muscular action has been measured in a pretty precise manner\*; but under some circumstances this action exhibits inconceivable energy, which it is impossible to appreciate.

The muscles, under some circumstances of life, overcome a resistance by which they would be broken in the state of death. It is astonishing to see weak, delicate women, who are habitually without energy, exercise, during paroxysms of the hysterics, convulsive motions which can scarcely be moderated by the most vigorous men. A slender delicate arm has frequently broken the strongest cords, dragged the heaviest bodies, and thus produced efforts which could not have been performed by the robust arm of a man in a state of coolness.

The strength of the muscles, the pliability and dexterity of their movements, are increased by moderate exercise and the power of habit. Every body knows to what a degree of perfection the mobility and precision of the movements of the

\* It results from experiments made with the dynamometer, by C. Regnier, that a man of mean strength, when standing perfectly erect, can raise a weight of 265 pounds, and that he can squeeze any thing between his hands with a power equal to 102 pounds.

Men and horses may labour a whole day and exert one fifth of their absolute strength.

muscles

muscles of the limbs, and of the throat, may be carried in tumblers, rope-dancers, and in particular fingers; and it may be readily conceived how unsatisfactory every chemical or mechanical explanation of this action must be.

The muscles scarcely ever act singly; and their different motions are always owing to the simultaneous or rapidly successive action of a greater or less number. The indefinite combinations, of which their action is susceptible, give to the limbs, by long exercise and the force of habit, the faculty of moving with an agility and a precision truly wonderful.

Almost all these movements are those of flexion or extension: the flexor muscles are called the antagonists of the extensors; and the former are always stronger than the latter, so that the state of rest, of relaxation, or of equilibrium, is found in semi-flexion, a state which the limbs naturally assume during sleep.

When the flexor muscles contract, the action of the extensors ceases, and *vice versa*: during their contraction, the muscles become shorter and thicker, and form a projection which resists the pressure of the hand.

The muscles, which are habitually exercised, become more voluminous, assume greater consistence and tenuity, and their colour becomes darker. These organs, like all the rest, exercise

their functions by the influence of the nerves which seem to convey to them the principle of action. By long continued exercise the muscles consume this principle of action; it even appears that they can draw it off from the other organs, and thus reduce them to an instantaneous state of lassitude, which renders it impossible for them to act.

14. The greatest proof that men are essentially bipedes is, that they all walk on their two feet. We must not, however, believe that this exercise is so natural and so familiar to them, that they can all perform it with the same facility. This exercise, as well as that of the other organs, requires a sort of study, before it can be performed with all the advantage possible.

Standing is not a state of repose, but the effect of continual extension. In this position the head, which has a slight tendency to incline forwards, requires to be kept back, and the whole body fixes itself in such a manner that the centre of gravity falls between the two feet; the shoulders are thrown so much the more backwards as the abdomen forms a more considerable projection: this is particularly observed in the state of pregnancy.

During the first year of life, children cannot stand upright, because their pelvian limbs are  
still

still weak, short, and proportionally slender; because their head and abdomen, which, comparatively speaking, are exceedingly voluminous, incline more strongly forwards; and because their vertebral column has scarcely any curvature; but in the second year this disposition gradually decreases, the child makes an effort to stand, keeps itself upright, and tries to walk.

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SENSATIONS.



## SENSATIONS.

15. **B**EFORE we proceed further in explaining the phænomena of our different functions, it will be proper to examine the general action which foreign substances have on our organization; and this will naturally lead us to the organs of the senses, which bring us into relation with surrounding objects.

The bodies which touch us exercise an action on our organs in proportion to their mass, their velocity, and the chemical affinity of their molecules; and according to the peculiar structure of the parts susceptible of being affected in a direct or an indirect manner.

The first body which exercises an action on us by its weight, and which continues to act at every moment, is the atmospheric air: its pressure on the whole surface of the body is enormous. But we are not sensible of this pressure, because it is continued; because the air which surrounds us is in equilibrio with that in the interior of our organs, and because the fluids which, in a great measure, compose the material part of our organization, have need of the pressure of the atmosphere

sphere to keep them in the state of liquidity which renders them fit for that purpose.

The atmospheric air, as well as all other fluids, exercises an equal pressure in every direction; and its weight is in the ratio of its perpendicular height and the breadth of its base. The surface of the body has been estimated at about 1400 square feet; consequently we experience from the atmosphere a pressure equal to that of a column of mercury twenty-eight inches in height, and having a base of 1400 square feet, which makes about 30,000 pounds: an enormous weight, which, were it not for the reasons already mentioned, would crush us to pieces.

16. This pressure, to which we are habituated, becomes so necessary, that we find ourselves much indisposed when we ascend to the top of a mountain, where it is much diminished.

When the pressure of the atmosphere has been considerably increased, it produces a restraint which cannot be long resisted: this is what takes place under the diving bell, when a person descends to a considerable depth.

17. All other heavy masses, which exercise on our bodies an accidental action, may, according to their weight, bruise, crush, or destroy us; and thus produce accidents more or less dangerous.

Bodies

Bodies which strike us exercise a stronger action, according as their velocity is greater, and as the parts are less fitted or have had less time to yield to the shock.

All the *moleculæ* of bodies exercise an action on each other, called the force of affinity. This force exercises a greater action according as the bodies are more divided, and as they mutually touch each other in a greater number of points.

The *moleculæ* of bodies which touch us in a state of great division tend with greater or less force to combine with our parts; and this combination is always a sort of alteration or destruction, which the organization makes an effort to resist. This effort is exercised by an increased action of the different organs; so that every substance which tends to combine with our parts, begins by stimulating them with more or less force.

18. It is necessary that our organs should habitually retain that temperature amidst which they were developed.

The organs, in a great measure, are formed of tissues of vessels, and the sum of the capillary vessels is much more considerable than that of the large vessels.

If the fluids contained in all these vessels followed the different degrees of the temperature of the atmosphere, very considerable changes  
would

would take place in the whole organization, by their greater or less condensation and rarefaction; and all these aqueous or adipose fluids would freeze at a temperature below zero, and would melt or be evaporated at the usual temperature of warm countries.

But, every organized being has the faculty of maintaining itself at the temperature proper for it; and when it is overcome by excess of heat, or the violence of cold, it dies before its fluids acquire the temperature of the atmosphere. Hunter found this faculty even in vegetables.

Man can endure changes of temperature much better perhaps than animals: he is found in the most different climates; under the torrid zone, and on the borders of the frozen ocean. During long voyages, the same men have experienced a variation in temperature of more than 100 degrees, during which the blood remains between 38 and 40° (100 and 104° Fahren.)

We are acquainted with no degree of temperature under which man may not exist. The enormous degree of heat which Dr. Fordyce was gradually able to support is well known; and we know, on the other hand, what extreme cold the natives of our climates have withstood, during the very severe winters in Canada, Siberia, Nova Zembla, and Spitzbergen. It appears, that with good clothing, abundance of food, vinous and

alcoholized liquors, but in particular proper exercise, man in all climates may retain his habitual temperament.

19. The organization affords different means for resisting cold and for supporting heat.

When a man is exposed to a low temperature, the atmosphere draws off from him his caloric, and this loss of heat reduces him to a state of uneasiness, which excites him to motion. If he obeys this impulse, he walks or labours with energy; his respiration and circulation are increased; he has a greater appetite; digestion is speedier, and the disengagement of heat, which results from these different functions, is much more considerable. On the other hand, the action of cold tends to thicken the texture of the skin; cutaneous perspiration is diminished, and the loss of heat occasioned by its evaporation is much less.

But, if the abstraction of heat, effected by the atmospheric air, be considerably increased, and if the vital action is not sufficiently powerful to develop caloric, in proportion to the loss of it which is occasioned, the individual is gradually weakened and exhausted by the efforts of long reaction, and falls into a state of sleep, which, unless he receives speedy assistance, soon becomes fatal.



In the most northern climates, the savages go out to hunt during the severest cold ; and of those who are threatened with a slow and painful death, some know that they can die in an easier manner, by remaining exposed to the cold in a state of perfect rest.

Of the Dutch sailors, who wintered at Spitzbergen, the greater part of those who remained shut up in their wooden hut perished ; while those who went out into the open air, and who employed themselves in hunting and other exercises, survived and suffered very little inconvenience.

20. On the other hand, when a man is exposed to a very high temperature, he experiences an uneasiness of another kind : respiration, in consequence of inhaling air very much rarefied, is rendered more difficult and less energetic ; he experiences a tendency to repose ; his appetite decreases ; he eats little and drinks more ; the skin, directly stimulated by the contact of the warm air, becomes relaxed ; a secretion of sweat takes place in greater abundance ; the evaporation produced at the surface of the body carries with it a great quantity of heat ; and the individual is thus maintained at his usual temperature : but if the heat of the air continues or increases, in an excessive proportion, he necessarily sinks under it, and becomes exhausted, not only by the employ-

ment of the force necessary to free him from the excess of the heat, but also by the real loss of the juices carried off by an abundant perspiration.

To whatever natural temperature, therefore, a man may be exposed, the heat of his blood, when in a state of health, always remains at 38 or 40 degrees of the centigrade thermometer (104° of Fahren.)

Every time that the atmospheric air takes from him, or supplies him with caloric in excess, the whole of the organization makes an effort to return to and maintain itself at the habitual temperature. In either case, the vital power is at first exalted; and it may be said that the abstraction or addition of a certain quantity of heat is always in the commencement a stimulant to the organization.

When the stimulating action of the heat or cold is too violent, or continues too long, it wastes the strength and leaves the body in a state of feebleness or exhaustion more or less striking.

When a body strongly heated is applied to any organ, a great part of the heat communicated to it suddenly destroys its texture; the rest is conveyed to a greater depth, and acts as a very active irritant. The impression received is transmitted by the nerves to the brain; this organ instantly reacts on the affected part, as well as on the

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the whole of the organization, and produces that mode of action which constitutes the sensation of pain.

When aduſtion takes place in a palsied limb, the impreſſion is not transmitted, becauſe the nerves of the organic life are deſtroyed, and the ſenſation of pain does not enſue; but the other phænomena are the ſame, though ſlower in their progreſs, and take place by means of the nerves which accompany the veſſels.

When a part is inſtantly diſorganized by a very great degree of heat, ſuch as the application of a piece of iron brought to a white heat, the ſenſation is duller and leſs painful: it ſometimes happens that a patient, when a nerve has been deſtroyed in this manner, thinks he experienced a very intense degree of cold.

When a part has been diſorganized by heat, thoſe in the neighbourhood enter into a new mode of action. (See *Phlegmaſia*.) The dead part detaches itſelf; and there remains an excoriation or a wound, which cicatrizes in the uſual manner.

21. Light exerciſes a very ſtriking action on organized beings. Every living body, when expoſed to light, expands in a vigorous manner, and aſſumes a darker tint; the colour, ſmell, and taſte of the different products of ſecretion have a more ſtriking character: while beings which grow

up in the shade remain pale, stunted, and aqueous, and exhibit all the symptoms of feeble and languishing life.

The long continued action of light and heat on the human skin, in the most southern countries, renders it brown, and causes its mucous membrane to assume a black colour. This coloration may have been heightened and propagated by generation, and may thus have produced a variation in the human species.

22. The electric fluid, universally diffused throughout the atmosphere, seems to have a great influence on the organization. Every person may have observed, during stormy weather, especially when the atmosphere is damp and warm, that the body sometimes seems to be oppressed, without force and without energy, and that the limbs are as if exhausted with fatigue. This disposition does not correspond exactly with the state of the thermometer and of the hygrometer; but it might perhaps be marked by a proper electrometer. It would appear, that in this case the damp air, which is a very good conductor of the electric fluid, draws off that fluid from living bodies, and on this account they remain enervated and without reaction.

23. Every organized body, which is continually

ally immersed in an atmosphere saturated with water in a state of vapour, becomes pale, relaxed, and without energy \*. This is the case with some species of animals, such as sheep; with vegetable in general; and in particular with herbaceous plants.

24. Independently of substances universally diffused throughout the atmosphere, to the influence of which man is continually subjected, there are a great many others, with which he is intimately connected by nutrition, by his artificial wants, and by his health; or with which he is accidentally brought into contact. All these substances exercise on the organization an action, a careful observation of which is of some importance.

When foreign substances are in immediate contact with our organs, the following phenomena are, in general, observed:

1st. These substances tend to combine with the living body in the ratio of their chemical affinity; and thus make an effort to destroy the organic structure of the part to which they are applied.

\* The affection produced by the long continued influence of dampness, added to want of food, or to food of a bad quality, is distinguished in man by the name of the *scurvy*; in sheep and plants it is called the *rot*; in swine the *leprosy*, &c.



2d. On the other hand, the living organs tend to decompose or to *digest* these substances, and to reduce them to a state which renders them susceptible of entering into the circulation, and of thus serving to repair the nutritive fluids. The organs also make a continual effort to expel all those substances which are improper for nutrition.

3d. In the last place, the foreign substances, by their contact with the organs, produce an impression which may be transmitted by the nerves to the brain; and the result is a change in the general state, which constitutes *sensation*.

When a foreign substance tends to unite itself to the organic parts, with a force greater than that with which the organs are endowed to resist, the result is a real chemical combination. This combination does not completely take place, except when the nerves of the part have been entirely disorganized; but if vitality still exercises an action, this chemical phenomenon is more or less modified.

When the foreign body, applied to an organ, possesses a great force of affinity, the phenomenon has a perfect resemblance to that which results from the action of heat: the nerves are speedily destroyed, and the chemical combination is then effected to saturation. Such is the action of caustic alkalies, of alkaline earths, of concentrated mineral

mineral acids, of some oxides, and of several saline substances.

These different substances are employed in surgery to destroy diseased parts, or to open cauteries. Thus a bit of caustic pot-ash, applied to a portion of the skin, has a strong tendency to attract all its humidity; and the organ is soon dried up and destroyed. The alkaline substance then combines with the fat substances, and the result is a sort of soap; the living parts in the neighbourhood of the scar, and which have been irritated, enter into a new action; the scar detaches itself, and a common wound remains.

These different mineral substances, introduced into the alimentary passages, destroy in like manner the parts with which they come into contact, and produce accidents which often prove mortal. In such cases the wound made in the gastric organs, and the subsequent accidents to which it gives rise, are an evident cause of the person's death. These phænomena are altogether different from those observed in cases of poisoning; after which no trace of alteration is observed in the parts which received the poison.

When the vital power offers a partial resistance to the chemical action the phænomenon is modified. Thus, in a man whose organization is considerably weakened, a limb affected by a wound, or exhausted by long suppuration, presents but a

feeble resistance to the force of chemical affinity. The gangrene which, in some cases, ensues is the result of the chemical action of heat, of moisture, and of atmospheric air, on the limb half dead, which indeed exhibits all the phenomena of putrefaction, modified by a remainder of life.

In the last place, if the foreign body exercises only a very feeble action on the organs, it may remain in contact with them, and yet produce no accident. Thus, a musket ball remains without any inconvenience amidst parts, the action of which it neither confines nor impedes.

25. When the substances brought into contact with the organs are susceptible of an easy decomposition, as is the case with all those which arise from organized bodies, or which form a part of them, they are then digested by these organs, and reduced to simpler compounds, susceptible of being taken up by the absorbing vessels, and conveyed into the torrent of the circulation to form part of the nutritive fluid: the residue is thrown out by different passages.

These substances are digested not only at the surface of the alimentary passages, but also by all the organs. Thus the product of the secretions deposited in the splanchnic and articular cavities, the purulent collections, sanguinolent effusions, tumefactions, concretions, and urinary or bilious calculi,

calculi, may be *digested*; and being then reduced to their first principles they enter into the circulation.

The digestive power of the different parts does not depend on the dissolving action of the animal fluids. This distinct action is exceedingly weak, even in the digestive juices. But these substances are digested by a force peculiar to vitality, and which has no resemblance to chemical affinity.

If osseous concretions, calculous tophi, and the different kinds of calculi, are evidently digested by the action of the organs, under certain circumstances, there can be no doubt that the various liquids effused are also digested before they enter into circulation. It is, indeed, hardly to be believed, that the pus, urine, bile, &c. are taken up without alteration by the absorbing vessels, and thus conveyed into the blood. Besides, this hypothesis is destroyed by the ingenious experiments of Dupuytren. This anatomist ascertained that the injection of these substances into the veins always produces accidents more or less dangerous, and very often sudden death. It may also be added, that chemists have never found in the blood any of those foreign substances, which were supposed to be susceptible of passing into it with so much facility.

When a foreign body, deposited in an organ, cannot be digested in it, and if it form an incon-

venient stimulant, it gives rise to the development of a phlegmon, which suppurates; and the foreign body is then thrown out by the aperture along with the pus.

That the organs may be able to exercise on the different foreign substances that force which is necessary to digest or to expel them, they must enter into a new mode of action. This change of state in the organs is produced by the presence of the foreign body, and by the impression of contact which it exercises on the nerves of the part with which it is in relation.

26. After birth, the first sensations which the organs experience are always *painful*; and children give external signs of them by cries: they either cry or seem indifferent. But the organs, by their gradual expansion, acquire improvement, and the individual is at length able to appreciate a change of state which takes place in any part, though it be very trifling, and though it does not interrupt the natural order.

When this change of state tends to facilitate the execution of the different functions, and thus contributes to the *completion* of life, the *sensation* is *agreeable*.

The reaction, *cæteris paribus*, of the centre of the nerves, when an impression is received, is directed in particular to the part which has been touched;



touched ; and if this part has experienced an alteration in its organic structure, the impressiion is continued, and always produces a painful sensation.

The impressiion made on an organ is the more lively, as the nerves are more immediately exposed to the contact of the foreign bodies, and as their pulpy part presents a greater development at its termination.

The sensation which results from the impressiion made on an organ is the stronger, as its nerves proceed more directly to the centre of the cerebral organ (the brain). Under this point of view, the parts least proper for producing sensations are those, the nerves of which proceed to the trisplanchnic ; and those most conveniently disposed for producing lively and speedy sensations are the systems of organic life, and even those of relative life, or the organs of the senses, the nerves of which terminate directly at the encephalon.

A slight impressiion made on any part, the nerves of which correspond with the trisplanchnic, produces a change of state more or less striking, but does not occasion any sensation. When this change of state is continued or increased, and if it deranges the natural order of the organic system, of which it forms a part, the derangement becomes a new impressiion. This impressiion is  
propagated

propagated by the nerves of the organic system as far as the cerebral centre, the reaction of which on this system constitutes sensation.

Thus, the impression made on the mucous membrane of the genito-urinary passages, by the contact of the secretion of a blenorragia, or on that of the aerian passages, by the contact of cold, damp air, produces very often no sensation. A very striking new mode of action, however, is developed in these parts, the membranes of which swell up and secrete a new product. These changes soon become a new impression, and the result is a painful sensation, which takes place in consequence of a derangement in the functions of the genito-urinary and the respiratory organs.

After an impression made on a point of the viscera of the abdomen, there often takes place a new mode of action, which gradually increases, with an alteration in the organic structure of the part, but without producing *sensation*. These disorders are not felt except when of considerable extent, and when they produce striking derangements in the function of the system of digestion. This is what takes place in all the slow phlegmasiæ, commonly called *obstructions*.

27. A foreign body, to produce a new mode of action in the whole organization, does not need to be absorbed, and to be conveyed to all the parts,

parts, to occasion in them the different disorders which result from its presence. Nothing is necessary but that there should be an impression by contact on the nerve, and that this impression should be transmitted to the nervous centre.

All the instances quoted, in support of the opinion that morbid substances are absorbed, only prove that they may be so, but do not prove that they really are absorbed; while, in many cases, it is evident that nothing is absorbed, and yet the same effects have been produced. Thus, when the variolous matter has been introduced below the epidermis of the hand, there come on, in the course of a few days, redness, pain, heat, and swelling in the part which has been punctured; the pain is continued along the arm, with a reddish streak, which seems to mark the progress of the virus; and a swelling takes place in the glands of the arm-pit. At the end of some days the individual experiences a pain in the head, fever, and a general derangement, which seems to indicate that the infection has been universal, and that the virus has been conveyed, as is said, into the whole mass of the blood.

But an evident proof that this progress of the virus is not necessary for the production of all this series of phenomena is, that the same symptoms are exhibited when a thorn is introduced into the finger, though it is very certain, in this case,

case, that the thorn has not been absorbed. The presence of the thorn, under the epidermis, is not even necessary to occasion all these accidents; they might be produced by the prick alone. Thus a woman, whose fingers are very clean, pricks herself with a needle, which is also very clean; and the consequence sometimes is the same series of phenomena. Nothing indeed is necessary but the *prick*; it is it alone which produces all these accidents.

It is well known that many persons experience violent colics, and are attacked by diarrhœa, when exposed to cold in the feet. In this case, the impression of the cold represents the prick; and still an effect is produced on a distant part, though nothing has been absorbed.

After a blow or a fall, &c. there often come on severe disorders in organs very far distant from those which have been injured.

Hence it is evident, that the absorption of foreign substances, virus, &c. and the conveyance of them into the blood, to produce different diseases, is an hypothesis supported by no certain proofs; which is contrary to the general laws of organization, and which, instead of throwing light on these facts, tends rather to obscure them. The continual application of so great an error in the treatment of diseases cannot fail of being often dangerous.

The .

The impressiion of certain foreign bodies is of such a nature, that the reaction is always effected on the same organ, whatever be the part where they have been applied. Thus cantharides always produce a reaction on the genito-urinary organs : substances of this kind are said to have a *specific action*.

- Some substances cause an increase of general action, without producing derangement in any organ in particular, as is the case with opium and alcoholic beverages. When this intoxicating action has been long continued, or powerfully excited, the organs experience great weakness, and the exhausted individuals tumble down or fall asleep.

In the last place, some substances occasion a sudden derangement, or a general disorder, which produces instant death, after a few convulsions, without leaving any traces of alteration in the part which received the impressiion. Of this kind are those poisons called narcotic, the asphyxiating gases, and the poisons of some animals.

28. These observations on the phænomena of life give rise to several important considerations, which ought always to be kept in view.

Thus, the result of every impressiion made on a part provided with nerves, is a change of state, or new mode of action, in one or more organs, or in the whole of the organization.



Consciousness of a change of state, which has suddenly taken place in the whole of the organization, constitutes *sensation*.

The impression made on the organs which receive their nerves only from the trisplanchnic, occasions in these parts a slow alteration, which very often produces no *direct sensation*.

The alteration of these organs may then become the cause of sensation, when it is strong enough to disturb the organic system of which it forms a part.

The changes which take place suddenly in those systems of organs, the nerves of which proceed directly to the encephalon, or to its prolongation, always produce sensations.

The sensations are painful when the new mode of action tends to disturb the natural order of the functions; and they are agreeable when it contributes to cause them to be performed with more force and energy.

## ORGANS OF THE SENSES.

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29. THE organs of the senses almost all receive their nerves from the encephalon, by a very short passage. These nerves exhibit, at their termination, a peculiar structure, which renders them fit for receiving the impression of every thing around them, or which strikes them. By this disposition, the organs of the senses bring man into relation with every thing without him, by making him experience very strong sensations. The function of these organs will be the subject of the following observations.

30. *Touching.* The sense of touching resides in the pulpy termination of the nerves of the skin.

The cutaneous system is composed of the dermis and the epidermis. The dermis, or skin properly so called (*corium*), is a thick membrane, of a close and elastic texture. The numerous nerves which proceed thither traverse this membrane, and form at its surface a pulpy expansion difficult to be observed. This nervous termination is accompanied by a reticular tissue of sanguiferous vessels, exceedingly fine, and the whole is covered by a mucous stratum or coating, in which the colour of the skin resides.

The

The epidermis is a thin dry pellicle, which seems to be inorganic : it appears to be formed by the junction of small imbricated laminæ.

The disposition of the cutaneous system is exceedingly well calculated to maintain the nerves of touching in a proper state of moisture and pliability. The epidermis serves to secure these nerves from the immediate contact of external bodies.

The whole surface of the body possesses the tactile faculty, and may receive the impression resulting from the mass, from the volume, and even from the figure of the resisting bodies, as well as from their thermometric and hygrometric state ; but it is chiefly by means of the hand, and by long and continued exercise, that man is enabled to appreciate properly these physical qualities of bodies.

The admirable disposition of this organ allows it to yield to their figures ; to touch them in all their points ; to pass over their whole surface with great facility ; to lay hold of them, to press them, and to raise them up ; and thus to bring itself into relation with them in the most intimate manner.

The hand of man, which may be exclusively employed in the contact of bodies, is susceptible of acquiring, by long habit, an inconceivable degree of perfection and of delicacy, as has been observed

in

in some blind persons, who by the touch could distinguish even colours.

The hand, considered as an organ not employed for walking, is an attribute peculiar to the human species; and it has justly been considered as the principal instrument of his superiority over animals.

The organ of touching is that alone which brings us into immediate relation with the whole of the surrounding bodies. The other organs of the senses only receive the impression of contact, which results from some of their particular properties. These organs can be improved and become useful to us only so far as they begin to be exercised in concurrence with the organ of touching.

31. *Tasting.* The sense of tasting is only a more exquisite organ of touching, exercised by the membrane which envelops the muscular body of the tongue, and by that which covers the inside of the mouth.

These parts have the faculty of perceiving the impression made on them by some particular substances, and especially by those susceptible of assuming the greatest degree of divisibility, by dissolving in the saliva.

It is chiefly the upper part of the tongue, and the lips, that possess the faculty of tasting in the highest degree; because they are the first which

present themselves to receive the savoury substances, and because they are more habitually exercised in that operation.

The part of the tongue, on which the sense of tasting is more particularly exercised, exhibits a peculiar structure; it is covered with papillæ of different forms and sizes, which, when in contact with sapid bodies, enter into a kind of erection.

32. *Smelling*. The organ of smelling is composed of the membrane that covers the interior part of the nostrils.

This membrane has the property of receiving the impression, made on it by the contact of certain molecuæ of matter, in a state of great tenuity.

Before a substance can affect the olfactory membrane, it must be in the state of gas, or sufficiently divided to keep itself in solution or in suspension in an aeriform substance. Hence it may be seen, that all bodies are susceptible of assuming that state which is proper for affecting the organ of smell; and that all substances, very much divided, may become odorous bodies.

Bodies are not odorous in consequence of any peculiar property inherent in their nature, but only by the common faculty of affecting the organ of smell; so that certain bodies are odorous to one  
and



and not to another. A great number of substances are odorous to the dog and the swine ; but are not so to man.

Though, in general, a very small number of substances only are odorous, the greater part of bodies affect the sense of smelling, when in a state of extreme division, and conveyed to the olfactory nerve in sufficient quantity and for a certain time. It even appears that to some animals, such as dogs, every body whatever is odorous. The power of smelling appears, in general, to be in the ratio of the extent of the nasal fossæ.

When substances produce analogous sensations in the olfactory organ, they are said to have the same odour ; and substances which exhibit very little physical, chemical, or organic relation, very often affect the olfactory organ in the same manner ; so that it is difficult to determine whether the impression produced on the olfactory membrane, by the *moleculæ* of the odorous bodies, depends on the form of these *moleculæ*, or on their chemical composition.

The azotic and oxygen gas of which the atmosphere is essentially composed, and which are in continual contact with the olfactory membrane, make no impression upon it ; but these gases serve as an excipient to odorous substances, which they hold in solution or in suspension.

Atmospheric air conveys odorous substances to

the nostrils, while it passes through them to proceed to the lungs during respiration; so that those desirous of smelling with more force, must shut the mouth and make a strong inspiration through the nostrils.

The odorous *moleculæ*, thus deposited on the olfactory organ, make on it an impression of contact, which is propagated as far as the brain, and determines that organ to produce a movement of general and instantaneous reaction, which constitutes the sensation of smell. This movement of reaction is sometimes so violent that, in some women of excessive sensibility, it occasions vertigo or syncope.

The organ of smell, like all the other organs, is strengthened by exercise, and is weakened by too strong or too frequent action.

A man who is habitually in the midst of certain odours, even exceedingly strong, becomes at length insensible to their action; but he who is frequently in relation with odorous bodies of a different nature, and who continually studies their action, may acquire the faculty of smelling in an eminent degree, and perceive odours exceedingly volatile.

The membrane which lines the sinuses is thin and smooth; and its structure has no resemblance to that which lines the nasal fossæ: it is therefore probable that it does not serve for perceiving odours.

odours. The use of the sinuses seems to be, to retain a larger quantity of air.

33. *Seeing.* The visual system consists essentially of a very thin membrane, which lines the bottom of the eye, and which has the property of perceiving the impression made on it by the contact of the light, either direct or reflected, from external bodies, and refracted on it by the transparent fluids of the eye.

The eye is composed of three transparent bodies of different densities, placed one within the other; and each contained in a thin pellicle, which perceives the contact of the light,

This apparatus is enclosed in a double covering, thick and blackish in the inside, having in the fore-part a contractile aperture, before which is placed a cartilaginous and transparent segment of a sphere,

This dioptric arrangement has some resemblance to that of an achromatic telescope, or of a camera obscura. It seems to have acquired all its development at the period of birth.

In the function of the visual organ, if the luminous rays which proceed directly from the sun reach the eye, a bundle of them, equal in size to the aperture of the pupil, penetrates into it. This bundle is refracted by the humours of the eye;

and the parallel rays, which compose it, approaching each other, from the perpendicular direction, converge on the retina.

The contact of this luminous point produces, on the retina, a strong impression, which is propagated to the brain, and occasions a sudden and instantaneous change of state. This change of state excites in the eye a movement of reaction; the iris expands, the aperture of the pupil is contracted, and the eye-lids approach each other. These parts oppose, in this manner, the introduction of the luminous rays, the impression of which produces a painful and vague sensation.

The luminous rays which fall on bodies are reflected from every part of them in a diverging form, and the angle of their reflection is equal to that of their incidence.

To have a proper idea of the act of vision, we must suppose that a cone of light proceeds from each point of an illuminated body, and that all these luminous cones are propagated, in a diverging form, without being confounded.

The light proceeding from a body which falls on the aperture of the pupil, is composed of portions of all these luminous cones, which have their summits in different points of the illuminated body. But the whole of these portions of luminous cones form another inverted cone, the base of



of which is measured by the size of the body, and its truncated summit is equal to the aperture of the pupil.

To conceive the progress of reflected and refracted light on the retina, it will be proper to follow the course of a luminous cone, proceeding from one single point of a body; and what has been said of this cone of light may afterwards be applied to those which proceed from all the other illuminated points.

A luminous cone, which proceeds from any point of an illuminated object, reaches the eye in a diverging form. The rays of this cone, which fall upon the transparent cornea, pass through it, and are refracted from the perpendicular direction, in the ratio of the density and convexity of that cartilage. These rays continue to be refracted in passing through the aqueous humour, and reach the iris, which affords a passage to a quantity of light, measured by the aperture of the pupil: the rest are reflected. The rays of the luminous cone, which pass through the aperture of the pupil, soon reach the lens of the crystalline humour, and are more strongly refracted in the ratio of its convexity and of its density, which is greater than that of the other humours. These rays afterwards pass through the vitreous humour, and experience a third mode of refraction, in the ratio of the density of the vitreous body. This refraction then is



weaker than that produced by the crystalline humour, but stronger than that occasioned by the aqueous: so that the luminous rays, in passing through the three transparent bodies of the eye, are differently refracted, in a sort of zig-zag form. By these means, the rays which in traversing the aqueous humour began to be decomposed and to be separated, as in the prism, are again confounded or mixed in passing through the crystalline humour; and the decomposition produced by the crystalline is destroyed by the vitreous humour. In consequence of this arrangement, the rays traverse the eye without experiencing any alteration, retain all their purity, and are never tinged with the prismatic colours.

To avoid coloration with the prismatic colours in telescopes, several glasses of different densities are applied to each other; and this disposition, analogous to that of the eye, is distinguished by the name of *achromatic*.

In the last place, all the rays of the luminous cone, continuing to be refracted through the vitreous body, unite in one point, which strikes the retina; and it may therefore be said that the light, which proceeds from an illuminated point of any object, proceeds to the retina, forming two cones opposed to each other by their bases.

What has been here said, in regard to the progress of this cone, proceeding from one illuminated

nated

nated point of an object, may be applied to those which proceed from all the other illuminated points of that body, and which also proceed to the eye. All these cones of light traverse the eye in different directions, cross each other without being confounded, and converge on different points of the retina, preserving the same respective position, which they had when they proceeded from the illuminated object. All these luminous points describe, in this manner, the image of the object on a small space of the retina, producing on that nervous membrane an impression, more or less lively, and of greater or less extent. The rays which fall in a direction perpendicular to the axis of the eye, are propagated in a straight line, and experience no refraction.

The rays which diverge and fall on the choroid, are absorbed by the black coating of that membrane.

As the luminous cone, which proceeds from each point of an illuminated object, converges on the retina in the direction of its axis, it must occupy on that membrane a position, the reverse of that which it had in the object, and the image is consequently inverted; but to see objects in the direction of the axis of the luminous cones proceeding from them, is the disposition proper for making them appear to us upright. Besides, we have

have not the faculty of perceiving the top or the bottom, the right or the left, of our retina.

When the light which falls on the surface of a body is reflected entirely, it produces a determinate impression (white); but the impression changes when the body decomposes the light, absorbs one part of its rays, and reflects the other.

Light is decomposed into seven rays, which, being reflected in all the combinations possible to form the different images, produce on the retina an indefinite series of particular impressions.

Of the points which reflect the light, those which absorb it entirely produce a negative sensation (black).

It is not as an image painted on the retina that we have a sensation of objects; for this image would be of no utility. Another eye would be necessary to look at it. But it is because the luminous rays, in delineating that image, produce on the retina an impression of contact, more or less lively, and of greater or less extent.

The impression made on the retina, by the contact of the light reflected from objects, produces at first a very uncertain sensation: it announces that the bodies *exist* and are *different*, since they produce *variable* impressions; but these impressions give no idea of the form, size, or distance of the objects.

Though bodies of the same form produce similar

lar sensations; the impression produced by the reflection of the light could never have served for determining these forms; and if men had not been endowed with the faculty of *touching*, they could never have been able to tell whether bodies were round or square, according to the ideas which we affix to these words: they would only have said, the bodies, the reflected light of which produces the sensations A B.

A person born blind, when cured by couching for the cataract, does not all at once enjoy the faculty of seeing the light. When shown the cat which he has been accustomed to caress, he does not know what it is. When made to touch it, he immediately exclaims, "It is my cat, I shall no longer require the aid of touching to distinguish it." But this contact is absolutely necessary, and he might continue to touch it without seeing it, and to view it without touching it, and consider it as two different objects.

The impression produced by the light reflected from any body cannot enable a person to judge of its distance. The man born blind, who was restored to sight by Cheselden\*, imagined that all bodies shown to him were in contact with his eye; because he had been accustomed to receive impressions of touching by immediate contact, and not by the intervention of a reflected fluid.

\* Philosophical Transactions for 1718.

Since



Since light reflected by a body cannot enable us to judge of its distance, it can as little give us any idea of its volume: the size of bodies, indeed, forms the source of the most frequent optic illusions which we experience, and which we often cannot prevent, though we previously know that they will take place.

If an object, completely detached from others, be viewed through a hole, the person who looks at it has no means to enable him to judge of its magnitude and distance. He, however, forms an opinion of these two relations; and this opinion, in regard to distance, is always founded on the manner in which the object is illuminated; and, in regard to size, on a comparison of it with other bodies the size of which is known.

Bodies produce on the eye a stronger impression, according to the greater quantity of light reflected from them. (A small body, not much illuminated and situated at a small distance from the eye, may be confounded with another of the same form, which subtending the same angle may be strongly illuminated, of a very large size, and placed at a great distance. Hence the eye alone affords no means to enable us to form a judgment of the distance of an insulated body, placed in infinite space, and with which we are unacquainted. It, however, cannot be said that in all these cases the sense of sight leads us into an error, but only



only that it leaves us in uncertainty. This organ cannot be improved and acquire the faculties peculiar to it unless exercised in conjunction with the organs of touching.

Were the eye merely a machine, there would be only one point of sight out of which vision would cease; but it is a living organ in all its parts, which accommodates itself to a series of distances, of greater or less extent; which becomes longer or shorter; renders the cornea flat or convex, pushes it backwards or forwards, &c.; and the best eye is that which possesses, in the highest degree, the faculty of varying its forms in such a manner, as always to unite in the same point of the retina the most diverging rays, and those which approach nearest to a state of parallelism.

When we look very near at an illuminated object, the iris extends and sends back the most divergent rays. On the other hand, when we look at a distant object not much illuminated, the iris resumes its former state; the pupil dilates, and receives a luminous cone much broader, but which is composed of rarer light and of rays more divergent.

The quantity of light is diminished by propagation, in the direct ratio of the square of the distance.

Though we look with two organs we do not see two objects, because the luminous rays falling on  
both

both the eyes in the same direction, converge at the same time on both the retinas, and produce two impressions, perfectly similar, which are confounded. But, if this disposition be deranged; if the two eyes be not directed towards the object in the same axis; if one be turned to one side, or if a person voluntarily places them in a squinting position, objects are seen double. In this case, it is observed that one of the images seems always to be more illuminated or nearer than the other, which then produces two sensations.

To render vision distinct, the luminous cones refracted by the transparent fluids of the eye must reach the retina at the moment of their converging; for if they converge beyond or on this side of that membrane, the vision is necessarily confused. This precision of convergency on the retina is the result of the degree of the convexity of the cornea, of the refracting power of the humours of the eye, and of the distance between the cornea and the retina. When the natural proportions do not exist, and when the mobility of the eye cannot restore them, the point of sight is necessarily changed, as in the case of the myopes and presbytae.

The usual point of sight enables a person to read middle sized print distinctly at the distance of eight inches.

Objects to be distinctly seen must be placed at  
a distance

a distance proportioned to their size : thus to see a painting, one must remove from it to a distance double to its size.

Some persons, to see distinctly, do not turn the axes of both eyes towards the object in an equal manner ; this produces a deformity of sight called squinting. (*Strabismus*).

For the most part, one of the eyes only is not directed towards the object ; but sometimes this is the case with both.

Children, who begin to move their eyes about at random, before they look at any thing with precision, or who look at objects very near, contract a habit of squinting ; but this deformity gradually disappears. Strabism may arise also from a weakness of some of the muscles, which produces an irregularity of their action.

In this case, when it is not of long standing, it may be corrected by placing on the eye which squints a conical tube, blackened in the inside, and which ought to be gradually turned towards that side to which the eye can with difficulty be directed : this method must be often employed and for a long time.

Strabism may be likewise occasioned by an alteration of some parts of the eye. Persons squint also instantaneously when they look at objects very near, or with distraction, or when they are in an ecstasy.

Some

Some persons do not see objects distinctly but at a very small distance. In this case, the eye ball, for the most part, is elongated and projecting, and the cornea very convex. Persons who exhibit this disposition are obliged to place the objects near to their eyes; but they have the advantage of possessing good sight and of seeing distinctly the smallest objects. It may, indeed, be readily conceived that the object being placed nearer to the eye, must send out a more considerable bundle of luminous rays; and since the eye receives these rays under a greater angle, they are refracted with more difficulty and are longer in uniting. This disposition is necessary, because the retina is further distant from the cornea, on account of the greater elongation of the eye-ball, or of the greater convexity of the cornea.

If the rays which fall upon a convex and elongated cornea were more convergent, or almost parallel, like those proceeding from distant objects, they would be too soon refracted; their convergency would take place before they reached the retina, and vision would be indistinct.

Shortness of sight, which varies from half a foot to half an inch, is distinguished by the name of *Myopia*.

This affection exists in all infants, and gradually decreases: sometimes it exists till the period of manhood, and is gradually corrected by the depression



pression of the eye-ball, especially in persons who fatigue their eyes a great deal, by continual occupation at a very faint light. Persons very short-sighted appear, in general, to squint, because they are obliged to incline to one side in order that the object may remain illuminated; and because they often look with one eye, while the other rolls about at random.

Short-sighted people acquire a habit of not looking at those to whom they speak, because they can see nothing in their face.

Old men often exhibit a disposition contrary to that of myopia; they do not see objects but at a very great distance; and their eyes are generally flat.

Long sight, known by the name of *presbyopia*, and which extends even to three feet, is always very weak; it seems to arise from a flattening of the ball of the eye, which diminishes the power of refrangibility.

As the eye has less refractive power, and as the retina is brought nearer to the cornea, by the flattening of the eye-ball, the rays must necessarily be less divergent. These rays then being nearly parallel, are more easily refracted, and their convergency being speedier, may take place on the retina brought nearer to the cornea. But if the rays are exceedingly divergent, they are refracted with more difficulty; their convergency takes place behind the retina, and vision is indistinct.

In presbyopia, the sight is necessarily weak, since



the object must be distant, and because the mass of the luminous rays decreases in the ratio of the square of the distance; so that an object three feet from the eye sends to it a quantity of light nine times less than if it were placed at the distance of a foot. The difference between a myope and a presbyta is, that the former sees only by very divergent rays; while the other sees by rays almost parallel.

Myopia is corrected by placing before the cornea a double concave glass, which refracts the rays proceeding in a parallel direction from a distant object, and gives them that degree of divergency which they would acquire if the object were at the natural point of sight. Each cavity ought to be a segment of a sphere, the radius of which is equal to the distance between the cornea and the point where the object would be visible.

Presbyopia is corrected by placing before the cornea a double convex glass; this glass collects the divergent rays, and makes them to fall in a parallel direction on the cornea, which refracts them with more ease on the retina. The rays which the eye then receives in a parallel direction are as numerous as those which it would receive obliquely from the same point of distance; the object is seen very much illuminated, very distinct, and appears larger.

That vision may be perfect, every part of the eye must be in a sound state; the membranes and  
their

their humours must possess great transparency, and the nerves must be endowed with their full vitality.

The sight is weakened or impeded by spots on the cornea (specks); by opacity of the crystalline humour (*a cataract*); by palsy of the optic nerve (*amaurosis*); by confusion of the vitreous humour (*glaucoma*); and by all other alterations of which the different parts of the eye are susceptible.

The retina, considered as the essential seat of vision, is an organ endowed with a very fine and delicate sense of touching; since it perceives the impression of all the modifications of the light reflected from the bodies, and refracted on it by the humours of the eye.

This organ, which cannot enable us to judge of the magnitude and distance of bodies but by the aid of touching, is that however which recalls the greatest number of sensations in a given time; it brings the individual soonest into relation with external objects, by instantly passing over very large spaces\*. This organ, in consequence of habitual and continued exercise, acquires so high a degree of utility and perfection that it is exceedingly difficult to determine what is its real natural mode of action.

This field of action is more than sufficient to satisfy all our wants; but its extent is too limited

\* Light is said to pass over 164,000 miles in a second.

to gratify our curiosity : the eye, indeed, keeps us as far distant from the infinitely small object which is near us, as from the infinitely great one which it is impossible for us to reach.

34. *Hearing.* The organ of hearing consists essentially in a nervous expansion, proper for receiving the impresson made on it by the contact of the air, in a state of vibration.

The auditory nerve is expanded in the middle of a viscous fluid, contained in a membranous covering, and enclosed by the ossaceous labyrinth.

The labyrinth is composed of three semicircular canals, shaped like the shell of a snail, which have a communication with each other through the vestibulum, by means of six apertures, five of which belong to the three canals.

The labyrinth has a communication with the tympanic cavity by two apertures, one of which is round and corresponds to the bottom of the interior scala of the cochlea ; and the other proceeds into the vestibulum. The first is closed by a membrane, and the second by a small bone.

The tympanic cavity communicates with the bottom of the mouth by a long narrow canal (*the Eustachian tube*). This cavity is shut externally by the membrana tympani.

The membrana tympani corresponds with the hole of the vestibulum by a series of four small

bones, which are moved by a few small muscles. It is the base of the stapes which is applied to the hole of the vestibulum, where it is fastened by the periosteum; the handle of the malleus is fixed to the centre of the membrana tympani. All this apparatus is preceded externally by the auditory conduit of the ear, and by its concha.

Elastic bodies, struck or distended, change their figure, and return to their first state, by vibrations more or less manifest. During these vibrations, the integrant molèculæ of the bodies experience a particular movement, a sort of quivering or vibration, which is communicated to the surrounding air, and is propagated to a greater or less distance.

The column of air, thus in a state of vibration, which strikes the ear, produces on the expansion of the auditory nerve an impression of contact, which is communicated to the brain.

The vibrations of bodies which take place instantaneously, or in a confused and inappreciable manner, constitute *noise*; those which regularly succeed each other produce *sound*.

Noise or sound always arises from the entrance of air into the vacuity, left instantaneously by bodies struck or distended.

Air may enter into a state of vibration by an immediate shock; and it then produces noise, sound, voice, speech.

Sound is propagated in every direction with an

uniform velocity, of about 1142 feet per second, plus or minus the velocity of the wind, according as it is in a contrary or a favourable direction.

Sounds which strike elastic bodies are reflected at an angle equal to that of their incidence. Reflected sound exhibits the same phenomena as direct sound, and constitutes echo. Sound is stronger, and is propagated to a greater distance, according as the air is more condensed.

The intensity and propagation of sound increase as the square of the density of the air.

The force of sound is weakened by the humidity of the atmosphere; so that it is propagated more easily as the air is colder and drier.

Sound, by being propagated, decreases in intensity, as the area of the base of the cone which it forms increases. This intensity, therefore, is four times as weak when the distance is double.

Sound is stronger as the vibrations are greater; but it remains the same. Sound does not change, but when the vibrations are more or less numerous in a given time.

In grave or low sounds, the strings perform fewer vibrations in the same time than acute or loud sounds. When the number of the vibrations is too small or too great, the sound is not perceptible by our organs.

According to Euler, we cannot appreciate a grave sound which has less than thirty vibrations,  
nor



nor an acute sound which makes more than 7552 in a second.

These limits of sound, appreciable by the human ear, are included in the octave.

The number of the vibrations depends on the size, length, and tension of the sonorous strings. This number of vibrations is in the inverse ratio of the length and size of the strings; and in the direct ratio of the stretching forces.

Two strings are in unison when they perform exactly the same number of vibrations in the same time, and produce the simplest concord.

When an acute sound produces exactly twice as many vibrations as a grave sound, it is said to be its octave; and the double octave when it produces four times as many.

If the acute sound produces three times as many as the grave sound, it constitutes its fifth; and its double fifth when it produces six times as many, &c.

All the aliquot divisions of a string give the harmonic sounds of fundamental bass.

A sound is strong or weak, according to the greatness of the vibrations; grave or acute according to their velocity; and harsh or soft according to the particular nature of the instrument.

The quality of the sound depends on the nature of the instrument, and very often it is not known in what it consists.

The tone depends on the manner in which the instrument is played, and varies with the artists.

Sound, produced either by striking a bell or a string, the vibrations of which are communicated to the surrounding air, or by the immediate collision of the column of air, as is the case in wind instruments, is propagated in a diverging manner in every direction.

The sonorous rays which fall on the concha of the ear, are directed towards the auditory conduit, and strike against the membrana tympani. The vibrations are communicated to the air contained in the tympanum, and are thence transmitted to the fluid in which the acoustic nerve expands; and the nerve receives an impression of contact.

This impression is propagated as far as the brain, and instantaneously produces a general change of state, which is called the sensation of sound.

The movement of reaction, which the brain produces in all the organs, in consequence of the impression made on it by the auditory nerve, is often very remarkable. Thus a sudden and unexpected noise produces a new mode of action, which is particularly observed in the muscles, in the organs of circulation and respiration, in the gastric system, and even in the skin.

In children, a weak sound produces very little impression, though the ear has already acquired its whole development. This organ must be long exercised

exercised before it can acquire that degree of perfection of which it is susceptible; and to many persons the finest music is nothing but stunning noise.

But, when a tender and harmonious sound suddenly strikes an experienced ear, it immediately produces a particular change in the whole system; a sensation is experienced, as if something were flowing through every part of the body; a peculiar state of spasm is produced; circulation and respiration seem to be slackened; a sense of constriction towards the epigastrium is felt, and the skin becomes corrugated.

None but persons sensible to the charms of harmony can be fully acquainted with the change which may instantaneously take place in the whole organization, in consequence of enchanting music.

The peculiar effect produced on the organization by music depends, on the one hand, on the nature of its composition, and on the other, on the sensibility and peculiar disposition of those who hear it; and in all these points of view it exhibits results very different.

Music has so powerful an action on the organization, that it has often been proposed and even employed with success in the cure of some diseases.

It is instrumental music, in particular, when performed in an affecting manner, which produces

duces the greatest effect on man. This music seems to maintain, in every part of the body, a regular motion, which is renewed at each beat of the measure; and as we may say exalts the organization to such a degree as to make it overcome the greatest efforts. It is well known how much the sound of the drum facilitates marching, and what a degree of courage has often been produced during the time of a battle by a martial air.

It is in large cities, in particular, that the influence of music seems to be most remarkable. A young delicate female, who could not walk a few miles to a ball, when conveyed thither in a carriage, is sometimes able to dance four or five hours without intermission.

Were she to shut herself up in a room alone, and try to jump about in this manner, at the end of a quarter of an hour she would fall down on the floor exhausted with fatigue. It is the music, in a great measure, which renews and maintains this action; the splendour of the lights and dresses, and the presence of a handsome young man, contribute also to exalt it.

35. Some have often found it difficult to conceive how several sounds can be propagated simultaneously in the air, and how the ear can perceive them at the same time.

When two sounds are produced together, they  
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are either propagated successively in the most divisible parts of time, or they combine, unite, and form only one sound, which the musician always knows to be the result of two instruments; or both sounds are disturbed, become confounded, and produce only noise, which the ear is not able to appreciate.

What has been here said in regard to the simultaneous propagation of two sounds, may be applied to that of fifty, and serves to explain their mode of action on the organ of hearing. Two sounds, indeed, produced together, may necessarily reach the ear at periods the nearest to each other possible, and are then perceived one after the other; or they reach it at the same time, and in this case produce only a single impression, which is neither that of the sound A, nor of the sound B, but which results from the combination of both, and which often a musician only can distinguish, because he is acquainted with the formation of them.

It is very difficult to determine what is the action of each part of the ear during the perception of sound. The small muscles attached to the chain of small bones, which extends from the membrana tympani to the aperture of the vestibulum, may by their action stretch or relax that membrane; remove from or bring nearer to the aperture of the vestibulum



vestibulum the base of the flapes, and thus favour or oppose the propagation of sound in the labyrinth: but all this apparatus is not indispensably necessary for hearing.

The essential part of hearing, which is found in all animals, and which in a great number is the only one that exists, is the membranous capsule, containing the viscous fluid in which the auditory nerve expands. This nervous expansion alone can even transmit to the brain the impression made on it by the contact of a body in a state of vibration, and cause that organ to produce the general and instantaneous mode of action which constitutes the sensation of sound. The external part of the ear in man may be removed without great inconvenience; and the ears of dogs and horses, which are much larger, are daily cropped without doing them much injury. Obstruction of the auditory conduit does not occasion complete surdity; and though people stop their ears as closely as possible, they can still hear sounds of a certain degree of strength.

Hearing results from a vibratory motion communicated to the fluid contained in the labyrinth; and this motion may be transmitted even through the bones of the head, as is the case in fishes, which have no auditory conduit, and whose organ of hearing is enclosed in the cranium.

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The membrana tympani is often found destroyed, even with the loss of some small bones, and yet deafness is not necessarily the result.

Persons who have the membrana tympani pierced, can in smoking a pipe make the smoke issue from the ear : in this case the smoke passes through the Eustachian tube.

This guttural conduit of the ear, which has been supposed to contribute, in an essential manner, to hearing, because people often listen with their mouth open\*, seems to be destined for the purpose of affording a free entrance to the air into the tympanic cavity.

Though all the accessory parts of the ear are not absolutely necessary for hearing, they together contribute a great deal towards the perfection of that sense ; and the destruction of them tends always, more or less, to weaken it. Deafness is the necessary result of the loss of that fluid contained in the membranous labyrinth : in the bodies of some old men, who had continued deaf for several years, the ossaceous labyrinth has been found empty.

The fluid of the labyrinth may be effused into the tympanum, by the destruction of the membrane which shuts the aperture of the concha, or by the removal of the stapes, the base of which shuts the aperture of the vestibulum ; and these accidents must necessarily produce deafness.

\* Conticuere omnes, intentique ora tenebant.

Weakness of the auditory nerve occasions dullness of hearing ; a palsied state of it gives rise to complete deafness.

The spiral of the two scalæ, which the concha exhibits, has induced some to believe that it serves for receiving nervous cords, of different sizes, in a state of tension, and susceptible of entering into vibration and of putting themselves in unison with different tones ; and that under this point of view the ear resembles a harpsichord. But this system of extended cords, which would be useless in the midst of a fluid, is not to be found. The concha, which does not exist in all animals, and which varies in its form in different classes, seems to be destined only for the purpose of presenting a greater surface to the expansion of the auditory nerve.

The only condition necessary for having the sensation of sound is, the impression of contact made on the nervous expansion, by the vibrations of the medium in which it is placed.

The organ of hearing, which alone leaves only the vague sensation of a change having taken place in the ear, becomes of the greatest utility by its simultaneous exercise with the other senses, and concurs in an essential manner towards the progress of civilization, as it makes men to communicate, in a direct manner, with each other, by means of the voice.

36. To comprehend properly the progress followed by the organs of the senses, and by the muscular system in the development of their functions, and in their individual or simultaneous action, these organs must be observed in children at the period of birth ; and their progress must be traced during the first years of life and to the age of manhood.

At the moment of birth the foetus, habituated to a residence in the matrix, where it is surrounded by a fluid at the same degree of temperature, and in continual rest, without respiration and digestion, receives at its birth a sudden and lively impression, by the contact of solid bodies, by that of the light, by the change of temperature, and from the air which strikes it externally, and which is introduced into the lungs. The general change which is thus effected in all the organs, reduces it to a state of uneasiness, which determines the first movements it makes and the first cries it emits.

Soon after, the gastric system makes it experience an uneasiness which arises from a new want. All the parts of this system enter into action, and require the presence of that aliment on which they are destined to be exercised.

The muscular system, at first, performs only sudden and uncertain movements. The action of the flexor muscles, which is stronger than that of the extensors, keeps the limbs in an habitual state  
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of flexion. If the child be placed upright, its abdominal limbs perform alternate movements of flexion and extension, and stretch themselves against the resistance of the ground. Their arms move in every direction, and their fingers, habitually bent, grasp with violence every body that falls in their way, were it even a piece of hot iron. All these trials develop the function of the muscular system, and prepare it for more regular movements.

The eyes, at first, troubled and confused, become brighter, and begin to be struck by the impression of the strong light, and then by very luminous bodies and by splendid colours: this impression gradually becomes distinct, and the hands, already habituated to grasp, make further efforts for that purpose; the child then extends its arms towards the luminous object, and seems desirous to touch it, at whatever distance it may be.

In this case, the eye only learns that an object exists in the direction of the visual axis; the hand is directed thither, reaches it, touches it, and thus ascertains its distance, its form, and its volume, &c.

The case is the same with the organs of the other senses; they all mutually assist each other; and their individual perfection is the result of their simultaneous action.

37. The apparatus of locomotion, and the different systems



systems of the senses, the functions of which we have examined, are the organs which in an essential manner establish a relation between us and external objects. The aggregate of them, which constitutes relative life, gives for result a series of very remarkable phenomena. The central system, by means of the nerves, distributes to them the essential principle of life. The impression made on these nerves is transmitted to the centre of the cerebral system and modifies its action ; so that the action of the organs of motion and of the senses is subordinate to that of the cerebral system, as that of this system is subjected to different impressions, communicated to it by the nerves of these organs.

The impression made on the nerves of any part, by the contact of some foreign substances, may be ] transmitted to the centre of the cerebral system, and modify its natural action.

For the most part, the new mode of action is particularly remarkable in the function of the organ which has received the impression. At other times, it appears in a distant part, and sometimes it announces itself by an universal and uniform derangement.

The new mode of action which results from every change in the brain may become the cause of a new action, which continues ; so that the derangement is continued by the consequence of

its first result : such is the case in almost all diseases.

38. Sensations being the result of every sudden change which takes place in the whole of the organization, it is observed that children do not begin to give apparent signs of them, until this change is sufficiently strong to reduce them to a state of uneasiness. All their first sensations, indeed, are painful, and are announced by cries and movements. This state of suffering, in which the child is placed in consequence of its first sensations, is necessary to excite it to acts which must contribute to its preservation, otherwise, after being born, it would suffer itself, through indifference, to perish. But there soon take place in its organization changes of such a nature, that they are capable of destroying it, and which reduce it to a state of uneasiness it is incapable of supporting. It moves at random to change its position, in order to satisfy its wants, and pain becomes to it the first cause of all its actions.

Instead, therefore, of pitying in a ridiculous manner the fate of the human race, who are said to be born to suffer, and whose first signs of life are announced by cries, we ought to consider these cries, and the pain which produces them, as the first cause of the rapid development of all our faculties.

One of the most astonishing phænomena of the organization

organization presents itself even at this early period : the living being has a structure which must develop itself in a determinate order. When this order is essentially deranged, all the systems of organs experience an extraordinary movement ; a peculiar reaction, which lasts till calmness is restored, or until the equilibrium be entirely destroyed.

The general or particular state of disorder, of which the whole of the organization is *conscious*, and which constitutes the *sensation of pain*, is indeed the most important and most wonderful phenomenon of life. The impression of contact, made on the organs of the senses, is transmitted to the brain by means of the nerves, and produces there a new mode of action, the result of which is a certain change of state in the whole organization. This change of state, which constitutes sensation, may be instantaneous or continued for a longer or shorter time ; and in either case it essentially varies in three ways. 1st, It tends to derange the natural order of the functions, and constitutes the *painful sensation*. 2d, It tends to stimulate the organs in a proper manner, and to exalt their habitual action, which it causes to be exerted in a fuller manner, and constitutes the *agreeable sensation*. 3d, It does not sensibly disturb the natural order, and yet constitutes an appreciable change of state, which is the *simple sensation*. The painful sensa-

tions are the strongest and the first felt ; the agreeable sensations cannot be well appreciated but by repeated contrast with the painful sensations ; without the latter the agreeable sensations would be merely the natural action of the functions, exercising itself with more or less intensity. In the last place, the frequent and fully-perceived alternation of the changes of state, resulting from a perturbation of the functions and from their natural action, performed with more or less energy, gradually enables us to appreciate changes of state, though indifferent in regard to the organic order.

As the child grows up, and its organs are developed, it is enabled, by habit, to appreciate better the new modes of action which take place in its different functions ; and it at length becomes sensible to the slightest changes which are produced in its organization.

After a certain period, the child finds that it has experienced agreeable and painful sensations ; it makes an effort to avoid every thing which has already reduced it to a state of suffering, and endeavours to replace itself in those positions which it before found favourable.

Thus, to avoid pain and to obtain ease are the first elements of its education.

At this period, one begins to observe that these sensations are renewed without the presence of all those objects which at first produced them. This  
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phenomenon, which is undoubtedly the most important, and the most necessary to improvement, requires to be carefully considered.

39. In order to comprehend properly how a sensation may be entirely renewed, merely by the presence of a part of the objects which first produced it, we must keep in mind that the aptitude of the organs to discharge their functions increases by exercise; that they have all a great tendency to habit, to perform the same actions, and are endowed with a great force of imitation.

We, indeed, know that the organs are strengthened and improved by a proper exercise of their functions; and that at the end of a certain period they all perform with ease those actions which at first were attended with a great deal of difficulty. Thus, the muscles which, at first, perform only sudden and irregular motions, give by long habit and continued exercise movements, the variety, agility, and safety of which are inconceivable, as is observed to be the case in tumblers, dancers, organists, &c.; and it is to be remarked, *cæteris paribus*, that the musician, for example, who performs best a piece of music on the piano-forte and the violin, is always he who has exercised himself most on these instruments; and that in this department, as well as in others, it is always by long exercise that people are able to over-



come great difficulties, independently of the greater or less faculty which results from an advantageous organic disposition.

What has been here said respecting the muscular apparatus, may be applied to all the rest, and in particular to the cerebral system, the functions of which I shall here endeavour to explain.

Of all the systems of functions, that most habitually in action, no doubt, is the cerebral system, since it is continually distributing to all the parts the principles of life, by means of the nerves; and is continually receiving the impression made on these nerves by foreign bodies. I have already said that the change of state, resulting from an impression transmitted to the cerebral organ, and which constitutes sensation, does not appear to be felt by the child until this change is sufficiently strong to produce a considerable derangement in its organization; that the child then becomes sensible to the impression of objects which tend to satisfy its wants, and to cause its functions to be performed with more energy; and that it at length becomes able to appreciate a change of state which does not disturb the order of the functions.

When the child begins to receive these three orders of sensations (*painful, agreeable, and simple*), it is observed that the simple sensations are at first few in number, but that they embrace simultaneously a great number of particularities, not perceived,

ceived, which gives reason to believe that children *generalize*: in proportion however as the sensations are repeated they become complex by an *analysis* of the principal object.

Thus a child begins to see in its mother a woman, and all women make it experience the same sensation; but it sees its mother every day, and almost during the whole day: this sensation, therefore, which is so often repeated, allows the child to receive particular sensations by observing her height, her features, her dress, the sound of her voice, the care she pays to it, &c. All these particular sensations remain united to the general sensation, and are simultaneously repeated.

The case is the same in regard to all the objects with which the child is continually in relation: their presence, at first, makes it experience only one sensation, but which is afterwards rendered complex by the successive discrimination of the different parts which constitute it. All these particular sensations are always connected with the principal object, and are constantly renewed in the order in which they are acquired.

A series of sensations, produced by an object and its attributes, is then renewed entirely by the force of habit, on seeing one of the smallest circumstances which were connected with it, or merely by the sight of an object which exhibits any resemblance or analogy to the first.

Thus a series of sensations must be considered as a peculiar act of the function of the cerebral system, and of which the individual is conscious by the direct relation which this system has with the whole organization. This series of sensations is then repeated with the more facility, the oftener they have been excited. They may be entirely renewed, not only by the presence of the principal object which contributed to their formation, but by all its accessory circumstances ; by every thing which has a more or less direct relation with it, or a certain resemblance and sort of analogy to it ; and as there is no series of sensations, a part of which is not connected in some points with another series, it thence follows that they may all be renewed by each other, according to the relation which exists between them.

At the end of some years, the child which, by exercising its organs of the senses and of motion on all the objects around it, has already experienced a numerous series of sensations, susceptible of being renewed with great facility, and which, on the other hand, is irresistibly excited to action in order to withdraw itself from pain, and to satisfy its wants, is soon capable of comparing its present sensations with sensations recollected, and of combining them in a manner most proper for its preservation. It is thus that the first operations of the understanding seem to be performed. When  
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the development of these operations is well understood, it will be easy to trace the progress of those which result from the successive improvement of the intellectual organ ; for it is not so difficult to determine in what manner man has attained to the highest degree of improvement, as to conceive how he began to combine the first two sensations.

40. Among people less advanced in civilization, as the inhabitants of New Holland or the savages of America, the child during the first year of its life must exhibit nearly the same series of phenomena as among more enlightened nations ; but the further development of their organization is very limited, especially in regard to intelligence ; and man, in these countries, has only that degree of superiority over other animals which naturally results from an organization evidently more advantageous.

The people of these countries, indeed, notwithstanding their antiquity, have still a language exceedingly limited ; they are scarcely acquainted with the art of constructing huts ; they feed on fish, game, and the natural productions of the earth ; and none of them have carried their industry so far as to preserve animals for increasing their breed : in a word, the instruments of the greater part of these tribes are as yet exceedingly rude.

It is to be remarked, that these people inhabit  
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the finest countries on the earth ; and it is probable, that this circumstance has been an obstacle to the progress of their improvement. I have already said, that in a child the first excitement to action, the first thing that promotes its education, is the necessity it experiences of withdrawing itself from pain, and of satisfying its wants.

The man continues to experience the same principles of action, and is still excited to industry by the necessity of preventing or repelling the attack of his neighbours, or by the desire of invading them to seize on the fruits of their industry. But, in a fertile country, which furnishes for its few inhabitants abundance of food without much labour, and which being of a mild temperature does not reduce them to the necessity of securing themselves either from intense cold or excessive heat, man has no motives sufficiently powerful to induce him to make a rapid progress towards improvement.

Among these people, the progress of the development of the different organs being very inconsiderable may be readily conceived ; but in some countries of Europe man, during a great number of ages and continual revolutions, acquires such a degree of improvement, that he can no longer discover the point from which he proceeded, nor trace out the path which he pursued.



41. I shall not here enter into a long detail of the slow and successive progress which man must have made before he could attain to his present degree of intellectual improvement; this labour would be tiresome and useless. Having exhibited a view of the manner in which the intellectual faculties are first developed among different orders, and having given a short description of the state of man among the most ignorant tribes, I shall pursue the further development of the human mind among the most civilized nations.

The child which is educated among an enlightened people learns, at an early period, to employ that instrument which becomes to him the grand means of communication and of improvement. Language has not been given to man, like hearing and seeing, as is commonly supposed; it is the slow and laborious result of his industry; it is one of the great difficulties which he has been able to overcome.

To speak is a thing so difficult, that children, if not early accustomed to it, are scarcely able afterwards to acquire the faculty of speech, as has often been observed in individuals educated alone in the woods, and as may be seen at present in regard to the savage of Aveyron. This child, who possesses a good common understanding, finds it exceedingly difficult to pronounce a few words; it was  
much

much easier to make him comprehend that we expressed things by written signs, and to teach him these signs, than to make him pronounce the sounds which expressed them. Thus, when he is about to walk to the observatory, where he sometimes receives milk, he takes his copper letters in his pocket, and combines, before the person who gives him the milk, the four letters which represent that substance. Speech results from the successive and simultaneous action of a great number of small muscles. This action is exercised in speaking with a mobility and precision which can be acquired only by long exercise; so that it must be as difficult to teach a person to speak, who has spent the first twenty years of his life alone in the woods, as to make him play on the harpsichord.

What still further proves that language is merely a human acquisition, and that man does not naturally speak with facility is, that persons born deaf are always dumb.

What valuable advantage the child derives from its intimate relation with its mother, who is continually under the necessity of speaking to it, and who always points to the object when she pronounces the word which expresses it? The child is thus irresistibly excited, by its propensity to imitation, to make an effort to pronounce the same sound. The organ in developing itself is properly modified

fied for that exercise, insensibly contracts a habit of it, and at length appears to have acquired it without difficulty.

The propensity to imitation, which in children is very great, would be continued with age, as in apes, were not its place occupied, sooner or later, by a desire of acting according to the dictates of the will.

This tendency appears to be merely an extension of the faculty and of the need of involuntarily repeating actions which are familiar to us; and is extended even to actions which we see performed.

At the end of some years, when the child has heard pronounced, and has itself repeated, a great number of times, the words which represent all the objects with which it is in relation, and when it has contracted the habit of applying them speedily, and with ease, to the things represented; in a word, when it begins to speak, its instructors do not fail to teach it that all these words are represented by conventional signs. By long exercise it at length becomes able to distinguish them with ease, and to follow with rapidity their combination in the formation of phrases; and at last acquires the habit of delineating them itself: that is to say, it can read and write. When possessed of these instruments, and when they have become very familiar to it, the function of its intellectual organ soon becomes extended, and in the development of it all the principal

principal phænomena of intelligence may be observed.

42. It has been already repeated several times, and it ought never to be forgotten, that *sensations* are the result of an impression transmitted by the nerves to the brain, which experiences a new mode of action, followed by a general and instantaneous change of state in the whole of the organization.

Sensations are direct or recollected. Recollected sensations are more particularly distinguished by the name of *ideas*.

Ideas are always renewed in consequence of some direct sensations which recall them. The faculty of recalling a more or less extensive series of ideas, in consequence of a small number of sensations, constitutes *memory*.

When we have acquired a great number of different sensations, every thing which surrounds us may recall them every moment; and we may continually experience a thousand incoherent and incongruous sensations. This, indeed, is the case with many persons, and particularly with children, who are then said to be subject to *distraction*.

The faculty of recalling all those ideas which have been acquired, in regard to any object, exclusively of those which have only a very distant relation to it, constitutes *attention*.

This faculty is one of the most difficult to be obtained.

obtained. It is acquired by long habit and close application to one particular subject ; it is one of the conditions most necessary to the improvement of the understanding. Vicq-d'Azyr is of opinion, that the greatest obstacles to the improvement of apes, arises from their distraction and great mobility.

43. When a child has several times experienced a certain number of sensations, he soon begins to *combine* them, and to *act* agreeably to the result of that combination. The development of the faculty of *combining*, which is properly that of the understanding, is the most important to be observed.

I have already said that the first sensations of a child are painful. By these sensations it is irresistibly excited to *act*, and to *cry*. It then begins to move at random, and to send forth cries until the pain be allayed or the want satisfied.

After the painful sensations, it is soon observed that it experiences sensations of ease ; and that it finds in the means proper for satisfying its wants a source of enjoyment and happiness.

At the end of some time, when the same actions have been often repeated, it is observed that sensations begin to be renewed in the child, without the concurrence of all those circumstances by which they were at first produced. Thus the  
fight



fight of the mother, who has often satisfied its hunger, by exciting an agreeable sensation, recalls to the child a series of sensations already experienced. It *dwells upon* these renewed sensations ; begins to have attention, and thus learns to *think*. While it thus dwells on its first sensations, others relating to the circumstances which accompany the act of lactation are renewed ; it endeavours to satisfy a want, to place itself again in an agreeable situation : after this period it *combines* sensations with ideas ; it *judges* and *reasons* ; it then *determines* in consequence of its judgment, and thus produces an act of *volition*. It is indeed observed that it wishes to approach its mother, and that it makes an effort to lay hold of the breast with its lips.

If the first acts of intelligence in the child be thus carefully and minutely observed, and if the connection of them be properly followed, it will be seen that they are the necessary result of different known properties. Thus it is remarked that the child *acts*, because it is irresistibly excited to do so for its preservation, by the stimulus of pain ; and that it combines the present sensations with the past, because sensations are renewed without the presence of the principal object, and merely in consequence of some circumstances connected with it, and which recall it. But if, instead of following  
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this progress, we take the strongest act of the human intelligence, and endeavour to discover there the formation of the operations of thought, we shall find nothing but an *immense abyss*, and lose ourselves in conjecture.

44. Having followed, in the child, the connection and succession of the first acts of the function of its intellectual organ, employed almost exclusively in satisfying the first wants of life, we at length come to the period at which it begins to enjoy all the advantages of fictitious signs, and to employ language with facility. We may then easily judge in what ratio the progress of its intelligence must increase.

By pursuing our examination of the organic phenomena still further, we shall find the first cause of action which, as already said, is the irresistible tendency to avoid pain, to satisfy wants, and to obtain ease, joined in succession by many other principles of action, in fondness for power or for respect; in the desire of acquiring knowledge, and in that of gratifying all our fictitious wants, all habits, &c. It is observed, that the means of satisfying these wants are developed along with them, and that they are merely an extension of the first faculty of providing for our preservation, by a concurrence of actions more or less strongly combined.

A more profound examination of the phænomena which result from a combination of sensations and ideas belongs to metaphysics, and does not fall within the plan of this work.

Metaphysics ought to be only a necessary consequence and continuation of physiology; and when not founded on a knowledge acquired in regard to the organization, it will be unintelligible to all those who cultivate the exact sciences.

45. It has been already said that sensations always consist in a new mode of action, produced in the cerebral organ, the result of which is a general and instantaneous change in the whole of the organization, and sensations have been distinguished into three kinds. In the first two, the change of state tends to disturb the habitual order of the functions, or to favour it (*painful and agreeable sensations*); and in both these cases an action is produced on a part. A sensation of pain or of easiness is experienced in an organ. In *simple sensation* there is still a general and instantaneous change of state; but without perceptible alteration in the natural order of the functions, and though a sensation is produced, the nature of the change which has taken place cannot be appreciated, nor is the seat of the sensation known.

There however can be no doubt that simple sensations arise from a general and instantaneous change

change of state; and this change, which is not habitually perceptible, becomes very appreciable when it has more intensity. Thus, of the sensations which we receive by the eyes and the ears, when some of them suddenly recall a series of ideas which interest us in a lively manner, this change of state then becomes considerable, and easy to be appreciated.

Under these different circumstances, a sensation as if something liquid or cold were circulating throughout all the parts of the body is experienced; a sensation of sudden cold, of violent heat with perspiration, or an oppression towards the epigastrium are felt. Sometimes this derangement is so sudden and strong, during extreme joy or a transport of passion, that it may produce syncope and even death.

The phænomena resulting from the habitual exercise of simple sensations are commonly indicated by saying: the influence of the moral part on the physical, which in regard to many persons denotes the influence of nothing on something; but it is evident that simple sensations, or sensations unaccompanied with any remarkable derangement of the functions, are of the same order as those which are accompanied by changes in these functions: they are all equally the result of a new mode of action, excited in the cerebral organ, which produces a general and in-

stantaneous change of state in the whole of the organization.

46. To experience a sensation, which may be conveniently compared and produce consciousness of the change of state which has taken place in the organization, it is necessary, 1st. That the cerebral system should be sound, and in full vigour : no distinct sensation indeed is experienced in diseases accompanied with a derangement of the cerebral organs. 2d. That the nervous communication, established between this system and the organ which receives the impression, should not be interrupted ; for if the nerves of one part be tied, cut, or palsied, the impressions made on them produce no sensations. 3d. That the organ should be in a particular state of action which constitutes *vigilance* ; for to make a person hear, it is not sufficient that you speak to him, he must also hear : it is to hear that the part enters into a sort of tension proper for that purpose ; the case is the same with the other organs, though in a manner less sensible. When the organs of a person are not sufficiently distended to perceive, it is said that he is inattentive.

All perceptions, experienced without these conditions, cannot produce consciousness ; and the movements they occasion are not the result of volition,



volition, but of the force of habit, in consequence of the new mode of action transmitted to the brain.

47. When the organs of the senses, after long and severe exercise, can no longer preserve that degree of tension necessary for perception, they fall into a sort of collapse, and pass to a state of rest which constitutes sleep.

Sleep is not produced by the repose of some organs exclusively, but is the more complete according as a greater number are in that state of collapse; and it is to be observed that almost all the organs may be in action in different states of sleep.

Thus, the organs of loco-motion are in action during somnambulism; and a person during sleep may be affected by the senses of smelling, tasting, and touching. Some speak in their sleep, and if asked any question they sometimes give a direct answer, which proves that they hear. The sense of seeing is the only one which does not perform its functions during sleep in regard to external objects. The cause of this seems to be, that the organ of seeing suddenly procures a very great number of sensations at a time, which always tend to awaken. It is well known that the organs of generation are often put into action in

the time of sleep, especially during lascivious dreams, and in the season of love.

It is almost needless to mention that the functions of the organs of circulation, respiration, and digestion, as well as of those of secretion, are not interrupted in the time of sleep.

Those actions, which are the habitual result of recalled sensations, may be produced during sleep, by the force of habit, when that change of state, which generally constitutes these sensations, is renewed in the brain by certain circumstances.

These actions consist in a combination of recalled ideas; and sometimes in the exercises naturally resulting from these ideas, as is observed in the case of somnambulism and of dreams.

If the change of state, reproduced in the brain, be analogous to that which the optic nerves have made it already experience by the sight of any object, the individual will believe that he still sees it. The same thing may take place in regard to the other senses.

As a sensation renewed may recall many others which have accompanied it, a single one may reproduce a series of ideas, sometimes well arranged, and often very incoherent or ridiculous.

If the change of state in the brain happens suddenly to vary, the individual will immediately experience another order of sensations, which may  
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have no relation with the former; and if these new sensations are of such a nature as to affect him in a lively manner, they will determine the habitual action of the organs: he will speak and even rise up to perform things agreeably to the ideas which are renewed.

When a person agitated by lively affections is asleep, the heat of the bed, an uneasy position, or difficult digestion, may occasion a change of state in the brain, which will be sufficient to produce dreams.

It is observed, *cæteris paribus*, that sensations which are most frequently renewed during sleep, are livelier and make a stronger impression than those experienced while awake.

48. To combine, properly, sensations acquired in a state of watchfulness, the organs which perceive, and the cerebral system to which the impression is transmitted, must be in that perfect state of equilibrium which constitutes health.

If the function of the cerebral system be deranged or disturbed, it cannot properly perceive the sensations received by the soundest organ; and every thing will appear to have the impression of that disorder which prevails in the brain.

Such, in all probability, is the very simple reason of the derangements of the intellectual organ

observed during paroxysms of hysterics, hypochondriasis, melancholy and mania; and of those observed in a great number of diseases, from the slightest delirium to the most dreadful convulsions.

49. It is to be observed, that the changes of state which take place in the whole organization, in consequence of impressions received, and the different movements which thence result, are of two sorts: we have a consciousness of the one; and the others take place, as we may say, without our knowledge.

The changes of state of which we are conscious, are those only which can be agreeable or painful to us.

Those which take place without our knowledge, are exceedingly numerous: some of them depend on the natural action of the parts; of this kind are the movements of the different organs of circulation, respiration, and nutrition; but if we have no consciousness of the habitual action of these organs, we experience a very speedy sensation of their derangement: the rest comprehend those disorders which depend on a derangement of the cerebral system; they often produce accidents exceedingly dangerous, and even death, without our being conscious of them, as in the case of epilepsy, asphyxiæ, apoplexy, &c.

These

These general considerations on the function of the cerebral system, and on the different modes of sensation, are sufficient to give a pretty correct idea of them. I shall therefore not analyse them any further, as this would lead me to details in the more obscure parts of physiology, which would be improper in an elementary work of this nature.

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## ACTION OF THE SYSTEM OF DIGESTION.

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50. THE human body increaseth, develops itself, is supported and modified every moment, at the expence of the blood, which, in the uninterrupted course of circulation, furnishes to every part of the organization the materials proper for the different changes which are continually taking place in it.

The blood repairs its losses by the product of digestion.

The aliments, introduced into the digestive organs, make their way through them in a slow manner. During their stay and their passage they become penetrated with the juices secreted by the mucous surfaces of the alimentary canals, and furnished by the glands; and they are gradually converted into a paste of a homogeneous appearance, which contains the chyle.

The chyle, taken up by the absorbent or chyloferous vessels of the same surfaces, becomes afterwards mixed with the venous blood.

The substances susceptible of being digested, are all those which arise from organized beings: vegetable and animal substances, and those which  
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enter into the composition of the same substances ; such as water, atmospheric air, &c.

The exercise of the gastric system is excited by the painful sensations of hunger and of thirst.

When the need of aliments begins to be felt, the individual first experiences a disagreeable sensation, which announces that the gastric organ requires to be exercised, and that it is disposed to perform its function in a complete manner. This first sensation (*appetite*) is the best seasoning for every kind of food.

But if a person remains several days without eating, he gradually experiences a sensation of ardour and twitching towards the epigastrium ; perspiration decreases, circulation and respiration become slower, and the individual falls into a state of great weakness accompanied with anxiety. At length, if this state continue, it produces death after dreadful convulsions, and the body passes speedily to a state of putrefaction.

That need, called hunger, is stronger the more active the life, and the more considerable the losses which the body sustains : it is increased at the usual hour of meals, and by all those objects which recall the remembrance of aliments. It decreases, or is instantaneously suspended, by every powerful distraction ; by the presence in the stomach of indigestible substances, and by compression of the abdomen.

During

During hunger, the stomach, completely empty, is contracted, and becomes reduced to a very small volume. This state must check circulation, and produce a painful restraint in the nerves; the result also is that the liver and spleen, being less supported, will twitch the diaphragm, and all these changes still contribute to increase the uneasiness.

A great many instances are mentioned of abstinence continued for several months, and even for several years. This may be conceived in the following manner: When a person dies of hunger, he does not perish by being exhausted in the same manner as a lamp is extinguished for want of oil; but the stomach, the function of which requires to be exercised, produces during hunger a general disorder, which becomes fatal if it continues. When the sensation of hunger is not called forth, life may be continued a very long time without nourishment, as has been observed in persons who remain in a state of absolute rest, as hypochondriacs, maniacs, &c. The digestive system then suspends its functions, like a limb which is at rest; the secretion of the skin stops; and the slight loss of heat and pulmonary perspiration which takes place is speedily repaired, at the expence of the inspired air, and of a small quantity of drink.

When thirst is suddenly excited by excessive  
heat.

heat and abundant perspiration, when the animal fluids have not that quantity of aqueous parts which belongs to them, the sensation experienced is much more painful and more insupportable than that of hunger.

Thirst produces a strong sensation of dryness, of ardor, and of constriction in the fauces, with a burning fever, and sooner proves fatal than hunger. It is quenched with much more certainty by acidulous or alcoholized beverages than by pure water, even when used in a large quantity.

In forced marches, during very hot weather, thirst may be prevented or allayed by moderate and frequent doses of alcoholized liquors, which support the strength and excite the secretion of a greater quantity of saliva.

51. It has been observed, that the hour of meals, the smell of ragouts, the appearance of a covered table, or the noise of the dishes and the mention of savory aliments, excite and put in play the gastric organs of gluttons and great eaters; the salivary glands already enter into action; secretion commences, and their mouths begin to water.

The aliments are first cut and pounded by the teeth, and at the same time are penetrated by the saliva, which flows in abundance, and the secretion

tion of which is maintained by the act of mastication, and by the favour of the alimentary substances.

It is of importance here to remark, that mastication is effected amidst a volume of atmospheric air, which is compressed and mixed with the aliments by the sides of the mouth; the saliva by its viscidty is exceedingly proper for retaining a certain quantity of it, and the albumen which enters into the composition of the saliva absorbs also a part of its oxygen, so that the alimentary substances are necessarily mixed, during mastication, with a certain portion of air; and when people swallow only their saliva it must necessarily carry with it into the stomach a very large quantity of air.

The aliments, properly pounded by mastication, and mixed with saliva and air, are afterwards collected into a ball by the action of the tongue. This alimentary bolus, compressed by the lateral parts of the mouth and the upper side of the tongue against the velum palati, is thrown backwards, and passes through the narrow part of the gullet, by pushing the uvula against the posterior aperture of the nostrils. When it reaches the back part of the mouth, it experiences a new pressure; it is compressed by the pharynx, and by a combined action of the different muscles of the throat:



throat: it descends behind the larynx, lowering the epiglottis, and passes through the œsophagus, from which it is conveyed into the stomach.

The aliments when conveyed into the stomach cease to be subject to the laws of chemical affinity: they become entirely obedient to the vital powers, and exhibit in their digestion a very remarkable series of phænomena.

By their presence in the gastric organ they act as a particular irritant, which excites secretion of the digestive juices, and produces a contraction of the stomach; so that the gastric juices, the pressure of the sides of the stomach, the heat and their residence in a living organ, are the principal causes which concur to transform the alimentary substances into a homogeneous pulp, already in some measure animalized.

Certain alimentary substances are more difficult to be digested than others; and though different stomachs exhibit great variety in this respect, there are some aliments, such as fat, which are generally of difficult digestion. On this subject we must refer to the curious experiments which Goffe, of Geneva, made upon himself.

When an obstruction takes place in the pylorus, the aliments which pass only with difficulty into the duodenum, are often rejected by vomiting; the calibre of the intestines then decreases, and the

the small quantity of chymous matter, which flows thither, is generally well digested.

I have observed, in the case of an obstruction of the pylorus with vomiting, that as long as the intestines continue to perform their functions, the upper part only of the patient's body becomes attenuated, while the lower half retains almost its usual plumpness. On the other hand, we frequently see the lower parts of children, during a long continued looseness, though the stomach digests well, become considerably wasted, while the upper parts retain their usual state. These two contrary observations are very remarkable in the history of digestion.

The stomach, after digesting the aliments it contains, is no longer stimulated in so lively a manner by their presence: its action then changes, and instead of that strong contraction which it exercised on them, it performs a regular motion (*the peristaltic*), which directs them towards the orifice of the pylorus, and makes them pass into the duodenum. This large and short intestine, affixed to the vertebral column only by a loose cellular tissue, and no ways secured by the peritonæal membrane, is susceptible of very great extension: it may with great propriety be considered as a second stomach, in which is performed a digestive action, no less important than that which takes place in the real stomach.

The

The chymous matter, accumulated in the duodenum, irritates this intestine, which contracts and secretes an abundance of digestive juices.

The presence of the alimentary substances in the duodenum excites the action of the pancreas, as well as that of the liver; the product of their secretion is effused in greater abundance in this intestine, and being mixed with the aliments contributes to complete digestion.

The fluid secreted by the pancreas is entirely similar to saliva.

The bile ought to be considered as a particular excretion of the liver, which in being evacuated serves for digestion, rather than as a fluid specially produced for the service of that function.

The vessels which bring back the blood from the stomach, the epiploon, the intestines, the mesentery, the pancreas, and the spleen, unite into three principal trunks (*the great and small splenic and the mesenteric*), which are soon confounded into one vein (*the sub-hepatic or vena portæ*). This arterial vein penetrates into the liver towards the middle of its transverse scissure; divides and subdivides itself there in an indefinite manner, and the blood which it thus conveys to all the parts of that organ, begins to assume the qualities necessary for becoming again arterial blood: it frees itself from a

part of the hydrogen and carbon which are contained in it.

The result of this particular excretion is the bile, a fat fluid, which by its mixture with a small quantity of soda forms a saponaceous liquor, evacuated by peculiar vessels.

The liver, therefore, must not be considered as peculiarly destined to secrete the bile, but as an organ in which the blood begins to resume new vital properties, by freeing itself from the superfluous matters it contains. How, indeed, is it possible to conceive that a most voluminous organ, which occupies a great part of the abdomen, should be destined merely for the secretion of a fluid, much less in quantity than that produced by a kidney or by one of the breasts?

This product of excretion, however, is not evacuated without contributing towards the organic functions, and it becomes one of the most powerful instruments of digestion. The bile is so necessary, that when it ceases to flow digestion is completed with difficulty; the chymous substance becomes dry, remains colourless, obstructs the intestines, and an obstinate tenesmus takes place.

The bile is formed by the venous blood which returns from the greater part of the viscera of the abdomen; but as this blood does not circulate  
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with great activity; and as its progress is checked during different circumstances of digestion, it appears that the spleen is destined to supply the liver speedily with venous blood, which ensures the secretion of the bile.

Hence it is seen, that every thing in the organization is employed in an economical manner, and that no power is lost. The excretion of the bile serves for digestion, as the excretion of the skin for lowering the temperature by evaporation; and as air expelled from the lungs serves for producing voice, &c.

The biliary vessels decrease in number, increase in size, and at length unite into a duct (*the hepatic*), which proceeds towards the duodenum. In its passage, this duct communicates with another, called the *cystic*, which proceeds into the gall bladder, where the bile may be accumulated, and remain a longer or a shorter time.

The presence of the aliments in the duodenum excites the action of the liver, and even that of the gall bladder; the bile flows from the hepatic duct and from the cystic; these two ducts terminate at a common duct (*the ductus choledochus*), which proceeds into the duodenum, two inches from the pylorus, and very near the aperture of the pancreatic duct: these two ducts often unite, and are confounded before they enter into the duodenum.



The chymous matter, pressed by the sides of the duodenum, penetrated by its juices, and moistened by the pancreatic liquor, and by the bile which stimulates that organ, acquires at length the ultimate degree of animalization, and forms a pulp which contains the chyle completely formed.

The alimentary substances, after this duodenal digestion, proceed slowly along the small intestines by the peristaltic action of these parts. During this passage, the digestive action continues to operate; and the chyle, which is separated from the rest of the chymous mass, is absorbed by the numerous open mouths of the chyloferous vessels, with which the surfaces of these intestines are covered.

At length, the alimentary substances pass into the large intestines; the absorption of the chyle and of the aqueous parts, which they contain, continues to take place; they acquire more consistence, are moulded into the form of the intestines, and reach the rectum, from which they are afterwards protruded. This protrusion is effected by the combined action of the sides of the rectum, and of the abdominal and diaphragmatical muscles, which overcome the resistance of the sphincter, and expel these useless *feces*.

52. The chyle, after being absorbed by the mouths of the chyloferous vessels, soon proceeds  
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into the glands, where it still undergoes a peculiar assimilation. It issues from these glands by larger and less numerous vessels, which afterwards proceed into a duct (*the thoracic*), situated in the posterior part of the thorax, and communicating with the left sub-clavian vein. This duct for the most part has a dilatation (reservoir of the chyle), at the place where the lymphatic and chyloferous vessels terminate. That on the right side is much smaller than the one on the left.

It must not be imagined that the whole product of nutrition proceeds into the thoracic duct: this passage is very apparent, but there are a thousand which escape our eyes, and through which the chyle may be conveyed to mix with the blood. It is well known also, that nutrition is not interrupted by a ligature of the thoracic duct. This duct must be considered as the principal artery of a limb, the size of which is much less than that of all the collateral arteries united.

53. Digestion is one of those organic functions which has the greatest resemblance to a chemical operation; yet it differs essentially from it in its principal phænomena. Whatever, therefore, be the nature of the alimentary substances employed; whether these substances be vegetable or animal, green, fresh, or in an advanced state of putrefaction, boiled or raw, dry or exceedingly fluid,

mixed with aqueous, acid, or alcoholic liquids ; whether one sort of aliment or a great number be used, and though mixed in all proportions possible, they always give for result, in a sound and vigorous stomach, a chymous substance, nearly of the same quality ; and in this substance the nature of the aliments, which have concurred to produce it, can no longer be known.

Digestion, considered under this essential point of view, has no resemblance to any of the known phænomena of chemistry ; it is entirely owing to the particular vital powers, and to that assimilating power which is found only in organized beings.

The operation of digestion produces in the stomach a very energetic centre of action, where all the powers seem to terminate. During this process, circulation and respiration are increased ; and a very remarkable shivering is experienced. The other systems of organs remain then in a sort of prostration, and exhibit great inaptitude for the exercise of their functions. Rest, therefore, is the state most proper to be in during this operation ; and it is that indeed which, on this occasion, all animals assume.

When stomachic digestion is nearly terminated the shivering ceases, the pulse becomes slower and fuller, and a slight perspiration takes place. During the process of digestion, the principal phænomena

phænomena of a febrile paroxysm are, therefore, observed.

It is not merely in the gastric organs and along the intestinal canal that digestion may be effected; substances susceptible of being digested undergo that process in every part of the organization.

Thus, a portion of animal or vegetable matter, introduced below the skin, or into the substance of the flesh, may be there digested, and at length entirely disappear; air injected into the cellular tissue, and liquids introduced into or effused in the cavities, may also be digested and absorbed. It is by a real digestion that bloody, purulent, and lymphatic collections, emphysemata, different tumours, and even calculi disappear. In all these cases, the action of the living liquids and of the assimilating power is every where observed. The organs make a continual effort to decompose the foreign substances with which they are in contact; since they absorb the materials suited to them, and reject the rest, either by the usual passages of excretion, or by a series of phlegmatic phænomena.

It is probable, that when substances are reduced to a very minute state the digestion of them is much easier: thus it is well known, that butchers who lead a life of repose amidst fresh meat are in general fat and florid. The *moleculæ* of the animal substances, which evaporate, are con-

veyed with the inspired air into the lungs, where they experience an easy digestion.

We shall have occasion more than once to show, that a function which is exclusively ascribed to one system of organs, may be performed in several other parts.

54. When digestion is completely effected in vigorous gastric organs, no disengagement of gas or development of acid or alkalies are observed: the aliments are completely digested, without emitting a putrid odour; and the breath retains its natural sweetness. But in a weak individual, the gastric system, being more or less debilitated, does not perform its functions with the same energy. The aliments then, which are not entirely subjected to the vital influence, are in the same state as if they were enclosed in any other place equally humid and warm; and chemical phænomena, more or less modified by the existing vital action, are observed: hence there is a disengagement of carbonic acid gas, of the gaseous oxide of carbon, of sulphurated hydrogen, &c. and a development of acid or alkaline matter.

These phænomena are frequently observed in febrile diseases, and in a peculiar manner in adynamic fevers, attended with extreme prostration of strength; and when the powers are very much exhausted. The aliments, left almost entirely to themselves,



themselves, speedily become putrid, emitting an odour so infectious, that this phænomenon has been considered as an essential symptom and a cause of those fevers, which have retained the name of *putrid*; but this putrefaction is only a natural consequence of the state of debility to which the gastric organ is reduced, and of the residence of the aliments in a humid and warm place.

55. Having considered the aliments as a substance proper for furnishing a repairing product, and having examined the principal phænomena by which the digestion of them is characterized, it will be proper to examine them under a point of view no less important, and to observe what is their action, in general, on the whole nervous system.

The substances introduced into the stomach always produce on the nerves of that organ an impression of contact, which may occasion a general or peculiar change of state, more or less appreciable. Hence substances introduced into the alimentary passages, all act as particular stimulants, whether they be susceptible of digestion or not.

In regard to their stimulating action, the nature of the aliments is not a matter of indifference to the organization. On the contrary, the aliments produce considerable changes in the whole

whole system, according to their peculiar quality, independently of the quantity of nutritive parts which they furnish. What a difference therefore must exist between people who feed on vegetable substances and who drink water, and those who live upon flesh and who use fermented liquors? The latter always possess more strength and more energy.

It may be readily conceived that the action of medicines is founded entirely on this property, which foreign substances have, of producing a change of state in the organization.

A great part of medicines are nothing but aliments, the stimulating action of which is more or less energetic, as is the case with all medicinal preparations extracted from vegetable or animal substances. Others are obtained from bodies little susceptible of being digested, but which possess a greater or less irritating action, as saline substances, metallic oxides, &c.: in a word, some nutritive substances produce their medicinal effect only when they cannot be digested, as is the case with manna, oils, &c. which purge merely by indigestion: when the stomach has sufficient power to digest them, they no longer produce the same effect.

Substances introduced into the alimentary passages exercise their action in one general mode; that is, by stimulating the nervous action. This  
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stimulating action is then varied, according to the nature and dose of the substance employed; according to the peculiar disposition, habits, and greater or less sensibility of the gastric system, in particular, and of the nervous system, in general.

The cause of the particular action of substances on the nerves, which depends on their nature or intimate composition, is entirely unknown; and we are unacquainted with the relation which exists between the composition of a substance and its action on our organs.

The action of substances is susceptible of variation according to the dose. A glass of wine gives a very agreeable stimulus to the whole system, and facilitates digestion; while several pints derange entirely the nervous action.

The action of a substance is very different, according as we are in a state of health or of disease, and according to the nature of the derangement with which we are affected. Opium, which produces violent effects in most acute diseases, though administered in small quantity, may be given in very large doses in tetanic affections.

The habit which the gastric system contracts of receiving the same substances, greatly diminishes their action, and people, by continued use, may accustom themselves to the strongest things.

The action, which depends on the composition of substances, ceases in proportion as they are decomposed

composed by the digestive force of the stomach; and this action is null when they are speedily digested: hence the reason why a great number of substances, which produce a strong action on a part destitute of epidermis, exercise none on the stomach.

In general, the result of the action of a substance is considered as its primitive or direct action. Hence it is said that the warm water which excites vomiting, and opium which produces an agitation often very strong, weaken and debilitate; because the consecutive effect of the first stimulating action is to leave the organs in a state of extreme debility.

The impression made on the stomach produces the same series of phenomena, as if it were made on any other organ: it occasions a change of state, for the most part remarkable in the gastric system, sometimes more striking in a distant organ, or sensible in the whole of the organization. Thus, some substances exercise their principal action on the stomach itself, and favour its function; of this kind are alcoholized liquors: others manifest their action on particular organs, such as the kidneys, the skin, &c. and on that account are said to have a specific action; some also produce a derangement in the whole of the parts, as is the case with those which are poisonous.

From these general considerations it may be

readily conceived how difficult it is to determine the action of the different substances conveyed into the stomach, the number of the causes by which it may be varied, and what opinion ought to be entertained, in general, of *medical substances*.

56. What relates to medical substances is an object of too much importance not to engage our attention for a few moments. Medicines, in general, are classed according to the effect which they produce, and a great number even according to that which they do not produce.

A man void of medical knowledge, who only casts his eye over the properties ascribed to medicines in a *Materia Medica*, must believe that the medical art has attained to the highest degree of perfection; since it possesses remedies which exercise an action in every manner possible. But those who have practised for some time will soon be convinced, that the wonderful qualities of these medicines very often exist only in the pompous names with which they have been decorated. To be convinced of this truth, nothing will be necessary but to run over the classification in some of the best works on the *Materia Medica*, such as that of Cullen.

This physician has arranged all the medical substances into twenty classes, some of which comprehend



prehend substances said to act on the fluids, and others on the solids; as if substances could act in any other manner than on the nerves and organs.

1st. The *nutritive*, are common aliments, and every thing that can be digested is nutritive.

2d. The *astringent*, are particular stimulants, which produce a constriction of the parts to which they are applied.

3d. *Emollients*, which essentially are warm aqueous substances. It cannot be said that their first action is debilitating, since the presence of warm water in the stomach excites vomiting or occasions perspiration; but when these substances have exercised an action for some time, they produce a state of relaxation and of evident weakness.

4th. *Stimulants*, are all those substances which, when applied to the organs, exalt their action.

5th. *Sedatives*, are also stimulants, which first produce a considerable exaltation of the nervous action, and exhaust or derange it to such a degree as to bring on sleep. Of this kind are opium, wine in strong doses, poisons, epidemic miasmata, and cold.

6th. *Antispasmodics*. Spasms being the consequence of exalted nervous action, every thing that tends to put an end to that exaltation is antispasmodic. Exaltation of the nervous action, in any system

of organs, may be destroyed either by changing that action, or by producing a stronger in some other part; and in all these cases the antispasmodics must be stimulants.

Bleeding is the best antispasmodic; but it is not a medicine.

7th and 8th. *Attenuants* and *inspissants*, are medicines supposed to have an exclusive action on the fluids, to give them more liquidity or consistence. It is certain that drinking for a long time in profusion, or the contrary excess, must cause the consistence of the fluids to vary; but this effect is only a very unimportant result of the use of liquid or solid medicines, the principal action of which is exercised on the nervous system.

9th. *Lenients* mean nothing, and ought to be confounded with emollients.

10th and 11th. *Anti-acids* and *anti-alkalies* produce the effect ascribed to them, merely by acting on the products of secretion, and not on the secretory organs. Thus pure magnesia, conveyed into the stomach when it contains acidities, can combine with them and form a salt, which acts afterwards as a stimulant. But the real anti-acids and anti-alkalies are all those stimulants proper for restoring to the organs the strength necessary to enable them to perform their functions completely, and to prevent the development of acid or alkaline productions.

12th. *Antiseptics.* Septicity depends in general on a weakness of the vital action, which permits the parts of our bodies to exhibit some phenomena of decomposition; and it may still be readily conceived that the only efficacious antiseptics are the *stimulants*.

The last eight classes, denoted under the name of *errhines, sialagogues, expectorants, emetics, cathartics, diuretics, diaphoretics, emenagogues*, are merely stimulants conveyed to a particular part, or which exercise a specific action on certain organs.

From this cursory view it is seen, that all these twenty classes of medicines may be reduced to stimulants, the mode of action of which is exceedingly varied, and some of which indirectly debilitate.

Though medicines are thus reduced to a general action, the choice of the most proper remedies in the different cases of disease is never a matter of indifference, and none but the skilful practitioner can determine properly in what manner they ought to be employed.

57. To sum up in a few words the whole of what has been said, we must consider, in the function of the gastric apparatus, 1st. The digestive action of the organs on the aliments; 2d. The stimulating action of the aliments on the organs.

In

In regard to the digestive action, we observe that the aliments are digested by their mixture with the secretions of the salivary glands; of those of the stomach, of the intestines, of the liver and the pancreas, and by their residence in a living organ.

When this function is completely discharged, it exhibits no analogy to chemical operations: but when the stomach begins to be weakened real chemical phænomena, which result from the simultaneous influence of the vital and of chemical action, take place. The chyle contained in the product of digestion is absorbed by the mouths of the chyloferous vessels, and passes into the glands, where it undergoes an ultimate assimilation: it then proceeds to mix with the blood through different passages, the most remarkable of which is the thoracic duct, connected with the left subclavian vein.

In regard to the stimulating action of the aliments, several principal facts are observed. The aliments have a great influence on the whole of the organization; and hence it happens that people who feed upon flesh, and who use fermented liquors, are much stronger and more vigorous than those who live only on vegetable substances, and who drink nothing but water.

The whole action of medicines is founded merely on the stimulating property of the sub-

stances conveyed into the alimentary passages: this action continues until the substance is digested or thrown out.

The Materia Medica possesses stimulants exceedingly various, some of which indirectly debilitate.

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## ACTION OF THE ORGANS OF CIRCULATION AND RESPIRATION.

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58. THE blood, taken at its departure from the heart, is distributed to all the parts of the body by means of the arteries, and returns by the veins, to the right side of that organ. To be conveyed then from the right to the left side of the heart, it distributes itself entirely to the lungs.

In this manner the blood continually performs a double circulation ; namely, a general circulation in all the parts of the body, and a particular circulation in the pulmonary organs.

We shall examine the phænomena it exhibits in this progress.

59. The blood returns from the lungs by four veins, which proceed into the left auricle of the heart ; this auricle, by its contraction, drives it in part into the ventricle on the same side, and this ventricle forces it into the aorta. The blood cannot return from the ventricle to the auricle on account of a valve (the *mitral*) which opposes it ; and it cannot flow back from the aorta to the ventricle, because it is still prevented by the sygmoid valves.

The blood which returns from the lungs is of a beautiful scarlet red colour; it is florid, spumous, somewhat warmer than the venous blood, and therefore exhibits all the characters of arterial blood. Being continually expelled from the ventricle and the aorta, by the action of the auricle, it is distributed to every part of the body, where its circulation is continued by the contraction of the arteries through which it passes.

The contractile force of the heart and of the arteries is maintained by the nervous action of these organs, and by the presence of the blood which flows thither.

The force with which the heart contracts has never been estimated in a satisfactory manner.

The movements of the arteries are isochronous with those of the heart; these movements seem to be instantaneously transmitted by the fluid of the blood.

The beats of the heart and of the arteries are owing to alternate movements of dilatation (*diastole*), and of contraction (*systole*).

The motion of diastole seems to arise not only from the development of the sides of the arteries, but also from a slight displacement of these vessels.

The motion of the heart and arteries is performed with so great velocity, that in adults they make about 80 pulsations in a minute. This  
number

number varies afterwards at the different periods of life, and in the state of disease. During the first years of life, the pulse beats 130 and 140 times in a minute; but this number decreases with age, and in old persons it scarcely gives 60 beats. In diseases, when the whole body is affected, it may be readily conceived that the nervous action of the system of circulation must be deranged, and that this derangement manifests itself in the state of the pulsation.

The pulse, in general, exhibits the same character in the same affections, and may serve as an indication of them to the physician, who has been long habituated to this kind of observation. But the advantages derived from consulting the pulse, in diseases, has certainly been much exaggerated.

The arteries, in distributing themselves to every part of the body, are divided and subdivided in an indefinite manner, exhibiting frequent anastomoses.

The sum of the small arteries is always much superior in capacity to the aperture of the trunk which furnishes them; so that the circulation must be less rapid in the rami than in the arterial trunks.

If the course of the arteries be traced out, they will always be seen to furnish subdivisions; the blood gradually seems to lose its red colour, and nothing is observed, but white vessels of the ut-

most tenuity, which at last escape the eye, even when assisted by the best microscope; so that the mode of termination of the arteries is still unknown.

It is proper here to remark, that animalcula, the size of which does not exceed the three or four hundredth part of a line, may be distinctly seen by the microscope. These animalcula, which increase, feed, and propagate, have in all probability vessels, the subdivision of which is very great.

If we suppose that each point of our body exhibits an organization equally perfect, and as complex as that of these animalcula, which is confirmed by microscopical observation, we shall then be enabled to form some opinion respecting the termination of the arteries; the subdivision of their capillary tubes; and the state of division in which the blood must be when it attains to that point.

From various observations, however, there seems to be reason for believing, that the arteries unite directly with the veins, and that the termination of the one is confounded with the origin of the other. What seems to be certain is, that the arterial blood may easily pass into the veins, and it proceeds thither with more ease according as the life is less active. Thus, when blood is drawn from an animal by an aperture made in a vein, this fluid issues, at first, with all its characters of venous blood; but in proportion as the animal becomes weaker,



weaker, the blood gradually assumes the arterial character, and seems at length to pass from the arteries into the veins, without having undergone any change.

But, however this may be, it is in the interval between the period when the blood escapes our eyes through the arteries, and that when we begin to see it return by the veins and the lymphatic vessels, that the most important phænomena of life take place. It is during this infinitely small space, that the different changes, continually going on in every part of the organization, are effected.

The arterial blood, which is in a state of extreme division, reduced to vapour dissolved in caloric, exhibits in this manner materials proper for all the secretions.

If the nerves continue to distribute to the organs the principle of action, necessary for the exercise of their functions, the phænomena of life may then be completely performed, and in different manners, according to the particular structure of each organ of secretion. Thus the saliva is secreted in the salivary glands, the milk in the breasts, the urine in the kidneys, the fluids at the surface of the serous and mucous membranes, the fat in the cellular tissue of all the parts: it is probable also, that the fluid which circulates in the

x 4

nerves,



nerves, and which conveys every where life and sensation, is secreted in the brain; and hence the vascular and nervous systems are continually in a state of mutual dependence.

The blood contains none of these products completely formed; but it presents materials proper for composing them.

When the arterial blood is distributed to an organ, the function of which is active, it undergoes very striking changes, and returns to the state of venous blood and of lymph; but if the nervous action on this organ be so weak that it does not properly discharge its function, the blood then passes from the arteries into the veins, almost without having undergone any changes.

It is well known that all the organs are composed of a tissue of vessels and nerves differently arranged, and in the interstices of which are deposited substances of different natures and densities, and that the vessels and nerves themselves exhibit the same composition.

The molleculæ of matter, which compose all these organic tissues, are continually experiencing changes: one part are incessantly removed, and their place is supplied by others, which gradually assume a different arrangement. During these continual changes, the repairing molleculæ increase always in density and number; so that the organs

organs gradually lose their pliability and their mobility, which in the course of time necessarily becomes a cause of death.

60. Amidst the continual changes which take place in every part of the organization, it must be observed that the substances excreted exhibit, in general, a greater density than that of the materials which served to produce them; or, in other words, that the substances which issue from our bodies have more consistence than those which enter them.

Thus we are continually losing by pulmonary and cutaneous perspiration, by urine and the other particular excretions; and these losses are repaired by the organs of digestion and respiration.

The materials which escape by the different passages are, in general, carbonic acid gas (the heaviest of all the gases); liquids charged with salts, acids, albumen, gelatin, &c. and fat substances.

The materials absorbed are: in the lungs, oxygen, and probably a little azote; in the gastric system, the chyle, the product of digestion properly so called, a great deal of water in the state of vapour, and consequently very pure, and probably air also introduced into the stomach.

But it is evident that, since the substances absorbed

forbed have much less density than those excreted, there must be a disengagement from them of caloric; and this disengagement is the cause of animal heat.

Thus the heat disengaged from the different parts is a result of the changes of density which the fluids continually experience in the different secretions.

The quantity of caloric disengaged is in the ratio of the activity of the organic functions; and this activity depends on the intensity of the vital force, or nervous action, to which all the phænomena of the organization may be referred.

The nervous action of the organs of secretion is maintained or excited by all stimulants, and even by the exercise of their functions.

When an organ is strongly excited, it becomes a centre of action; the blood flows thither in abundance, and secretion is effected with great activity. When the organs of secretion are not thus excited, or put into action, their functions flag and may even cease entirely.

61. The blood, after being distributed to every part, and after having furnished to each point of the organization the materials necessary for its particular secretion, returns by two orders of vessels, the veins and the lymphatics.

The

The veins bring back all that part of the blood which has undergone the least change: that which retains a red colour.

The lymphatics collect the products of all the ferous secretions, which are continually renewed, and all the aqueous parts, which hold in solution or in suspension the remains resulting from the continual changes effected in all the organs.

The veins, at first exceedingly small, soon unite to form more apparent ones, and these continue to join, exhibiting frequent anastomoses. The ramusculi by their union form rami, the rami branches, and the branches trunks, which terminate in two large veins. One brings back the blood from inferior parts of the body (the *vena cava inferior*), the other brings back that from the upper part (*vena cava superior*), and both proceed into the right auricle of the heart.

The veins, as they unite, always decrease a little in size; so that the diameter of a venous trunk is always smaller than that of the rami which concurred to produce it. By this disposition, the blood must circulate quicker in the trunks than in the branches.

The veins, at certain distances, are furnished with valves, formed by folds of their interior tunic: these valves are generally disposed in pairs; they prevent the return of the blood, and interrupt the continuity of the fluid in these vessels.



The veins which bring back the blood from any part, are always more numerous and of a larger size than the arteries which carried it thither; and this necessarily renders the venous circulation much slower than the arterial.

The blood circulates in the veins by the contractile force of their sides, assisted by the tonic action of all the neighbouring parts. This circulation is maintained by the nervous action of the veins, and by the presence of the blood which flows into their cavities.

The lymphatic vessels, much more numerous and smaller than the veins, are dispersed in abundance throughout all the parts, and particularly in the white organs, of which they seem to form the whole tissue. They absorb the serous liquids continually secreted in the different parts.

The lymphatics, by their numerous distribution, form an inextricable sort of reticulation: they unite like the veins to form larger and less numerous vessels. Like the veins, they are provided with valvular folds, generally disposed in pairs, which oppose the return of the lymph.

After a certain passage, the lymphatics proceed into the glands, the aggregate of which forms an essential part of the absorbing system.

These glands are small, round, or ovoid bodies, reddish, arranged in groupes, and which have the appearance of grains or seeds united. The lymphatic



phatic glands are observed, in particular, in the bend of the great articulations, on the mesentery, and along the large blood vessels.

The lymphatics which proceed to these glands lose themselves in their substance. The lymph which they carry thither undergoes a particular kind of assimilation; it then begins to resume those characters of animalization which it seemed to have lost, and issues from them by another order of vessels, less numerous and larger.

The lymphatics thus continue to advance towards the thoracic duct, uniting to form larger vessels, and traversing the glands which they meet with.

All the lymphatic vessels proceed, in this manner, to the thoracic duct. Those which come from the lower part of the body proceed into the abdomen, unite with the chyloferous vessels, and proceed together to the lower part of the thoracic duct. In this place, which is situated near to the upper part of the abdomen, this duct often exhibits a dilatation, more or less striking (reservoir of the chyle): it then traverses the diaphragm with the aorta, and ascends on the right side of that artery, as far as the summit of the thorax; it then runs on the left, passing before the vertebral column, and proceeds into the left subclavian vein.

The lymphatics which come from the upper part of the body proceed to different points of the  
thoracic

thoracic duct, near its insertion into the sub-clavian vein.

A thoracic duct is frequently found on the right side, but much smaller than that on the left, and formed by the union of the lymphatics, which come from the upper part of the right side of the body.

Circulation seems to be performed very slowly in the lymphatics; and this system, without doubt, is that which shows the least activity in its functions: the passage of the lymph through the glands contributes a great deal to check its progress.

The use of the lymphatic system evidently is to bring again into circulation the residue of all the secretions, after making them undergo a particular assimilation or sort of digestion.

This important function is performed slowly and without interruption; and is maintained by the action of the nerves, which are distributed to the lymphatics and their glands, and by the presence of the fluids absorbed and brought into circulation.

When the nervous action of this system is diminished, its function is checked; and the serous fluids, being no longer properly absorbed, remain in the large cavities or in all the tissues, which gives rise to dropsies of different kinds and to anasarca.

Physicians believed that they had found in the  
discovery

discovery of the lymphatic vessels an explanation of a great number of the phænomena of disease; and they began to make a false application of this knowledge, as is the case with almost every new discovery.

It was to the humorist physicians, in particular, that this discovery seemed to be of the greatest utility. As they ascribed almost all diseases to humours circulating in the fluids, they saw in the lymphatic system a convenient way of conveying them to every part of the body, and of making them proceed with rapidity from one place to another.

As the lymphatic system absorbs the fluids effused in every point of the organization, they imagined that it ought to absorb also all those foreign substances subjected to its action; and that it conveyed them to different parts to produce in them accidents more or less severe, or that it poured them into the blood *to infect its whole mass*.

But all these suppositions were mere conjectures, supported by no real proofs, and contrary to the progress of that function and to the common phænomena of life.

It has never been proved, by any direct experiment, that foreign substances can be taken up by the lymphatic vessels and conveyed to distant parts. The experiments made on purpose to ascertain the truth

truth of this fact prove, in an evident manner, the contrary.

Thus Dupuytr n, in his ingenious experiments on the chyle, tried, but without success, to produce an alteration in that fluid. He caused dogs to swallow animal, vegetable, and mineral substances of every kind, which he thought likely to effect changes in the quality of the chyle; but he was never able to alter, in a sensible manner, its nature, its colour, or its odour. The gastric organs, by their vital energy, oppose all these alterations: they digest every thing susceptible of digestion; absorb what is proper for them, and reject what might prove hurtful to them.

The case is the same with the lymphatic system of all the parts of the body. The foreign substances introduced beneath the skin, or conveyed into the substance of the organs, are not absorbed, without being digested and reduced to principles susceptible of entering into circulation; and substances taken up by the lymphatics, after this first digestion, do not pass into the venous blood until they have undergone a second assimilation in the lymphatic glands.

But the nerves of the different parts cannot withdraw themselves from the impression of the foreign bodies which come in contact with them. This impression may change the mode of action  
of



of the part, and produce a local phlegmasia; or be propagated as far as the cerebral centre, and give rise to general derangements, more or less serious, and which are ascribed to circulating humours.

62. We have already shown that the arterial blood proceeds from the left side of the heart to distribute itself to every part of the body, and to carry thither the materials for the different secretions; and that it returns by the veins, to the right side of that organ, from which it passes to its left side by traversing the lungs.

The arterial blood maintains itself always at the same temperature, and at the same degree of fluidity, by means of perspiration, and the secretion of the urine; and thus frees itself from the heat and water which it receives in excess.

The blood, which returns by the veins, resumes the qualities of arterial blood, chiefly during its passage through the liver and the lungs.

We shall here examine more minutely these important phenomena.

63. The heat of the blood is maintained by the continual secretions which take place in every part of the organization.

As the products of the different secretions have always more density than the materials which



served towards their formation, the result must necessarily be a continual disengagement of heat. This disengagement of heat is proportioned to the activity of the secretory functions: it is exceedingly weak when these functions are performed in a slow manner; and strong when they take place with great energy. A woman who uses little exercise, and only a very small quantity of food, has always a cool dry skin, and the greatest loss of heat is sustained by pulmonary perspiration. On the other hand, a man employed in severe labours, and who eats a great deal, has the skin humid and warm; and an abundant perspiration continually carries off a large quantity of his caloric.

Thus animal heat is one of the products of secretion; its excess reacts on the organs as a stimulant; and excites, in a particular manner, secretion and sweat. The evaporation of this fluid, secreted in excess, carries off from the surface of the body a great quantity of caloric, and by these means the temperature is lowered.

In proportion as the temperature of the body is lowered, neither secretion nor sweat are so powerfully excited, and the loss of heat ceases to be so great. It is by this organic regulator, that animal heat is always maintained nearly at the same temperature of 40 degrees of the centigrade thermometer (104° Fahr.)

In local phlegmasiæ, when a thorn, for example,  
has

has been introduced beneath the skin, the nervous action of the part is violently excited; circulation is accelerated; the secretions take place with more intensity, and the local heat is sensibly increased. But this augmentation of heat never extends beyond two degrees, and if its intensity appears to be greater, during the burning ardour which is experienced, this painful sensation ought to be ascribed, in a great measure, to the too strong nervous excitement, and to the derangement in the habitual order of the functions of the injured part.

Besides the loss of caloric disengaged by perspiration, the body habitually loses a great quantity of fluids by the skin and the lungs. The sum of the substances which escape by these two ways exceeds the half of the weight of the whole aliments; and pulmonary perspiration is equal to that which takes place by the skin.

The product of an abundant perspiration is much more aqueous than that of the habitual perspiration, called insensible: the latter is clammy and greasy, and affects a peculiar odour, which varies in the different parts in the two sexes, and even in different individuals.

Heat and labour greatly increase this excretion; cold and rest can entirely suspend it.

The secretion of sweat and that of urine seem mutually to supply each other's place, and the

activity of their functions is always in the inverse ratio of each other. When secretion of urine is impeded, an analogous excretion takes place by the skin, and the sweat assumes a urinary character.

64. The arterial blood throws out the quantity of aqueous parts, which it receives in excess, chiefly by the urinary passages.

A man, during the whole day, may do nothing but drink and void urine; and it is inconceivable what a large quantity of liquid may be thus made to pass through the body in a given time.

That a person may be able to drink a large quantity, without being injured, the water must contain stimulating substances, such as alcohol or acids; these beverages then solicit the organs to digest them, and at the same time excite the kidneys to separate from the blood a quantity of water, proportioned to that which has been drunk.

If the beverage is merely aqueous, and if taken in too great abundance, the gastric and urinary systems are not properly stimulated; the beverage is digested only with extreme difficulty, or cannot be so completely; and, in this case, a vomiting takes place, or even indigestion, which is often very dangerous.

This important consideration ought never to be lost sight of in diseases, in which it is necessary to  
avoid

avoid overcharging the weak and debilitated stomach with aqueous beverages. In this point of view the abuse of ptisans is much greater than is imagined.

Fermented liquors are necessary to men who feed on coarse aliments, with little or no seasoning, because it is always requisite that the stomach should be properly stimulated, either by the drink or the food. But when the aliments are strongly seasoned by the stimulating productions of warm countries, there is not much need for alcoholized liquors; and people will suffer much less inconvenience by abstaining from them entirely, than by contracting the habit of using them to excess.

The need of fermented liquors is felt in a much stronger manner in warm and cold countries, where the organization is continually struggling against the temperature, than in the moderate climates.

The arteries which proceed to the kidneys are very large; it has been estimated that their capacity is such as to afford a passage to the eighth part of the blood.

The quantity of urine separated in a given time, and the speed with which it is secreted in consequence of drink received into the stomach, has induced some to believe that there may exist a more direct mode of conveyance, than that by the blood, for transmitting liquors from the gastric  
 y 3 organs



organs to the bladder, and this function has been ascribed also to the lymphatic vessels; but this assertion is unsupported by proofs, and it is from not properly understanding the simultaneous action of several organs, in consequence of the same stimulant, that it has been thought necessary to recur to this hypothesis.

The urine sometimes assumes a colour analogous to that of certain substances received into the stomach; it has been supposed that this colour arises from the presence of these substances conveyed into the blood, and transmitted thence to the urinary system: thus the urine becomes sometimes red by the use of beet-root; yellow by that of saffron or jalap, but without containing any of these substances; for urine coloured yellow by the action of saffron has not the least smell of the stigma of that plant.

If the urine sometimes assumes the colour of certain aliments or medicines, it often exhibits one very different: thus it becomes green by tamarinds, blackish or puriform by oil of sweet almonds, &c. If an aliment or medicine could communicate to urine a part of its substance, it would doubtless be its odorous molecule; which, as appears, ought to penetrate every where with great facility; but this is never observed to be the case. Thus asparagus, which has an agreeable odour, occasions a very fetid smell in the urine; and turpentine,



pentine, the odour of which is very penetrating, gives to urine the sweet and agreeable odour of violets.

In all these cases, the changes which take place in the urine are the result of a new mode of action, communicated to the renal system. There is no organ of secretion, the product of which may not be changed, when a new mode of action is thus excited in it; and it is well known how various the secretion of the mucous membranes is in catarrhal affections, and what a dreadful character the saliva assumes in the hydrophobia.

Hence the changes which take place in the urine, in consequence of certain substances being digested, do not arise from these substances having passed into the urine in their natural state, but from the specific action which they particularly exercise on the kidneys, which changes their habitual mode of action, and alters the usual product of their secretion.

It is chiefly in acute diseases that the urine exhibits characters highly varied. Every time that the organization experiences a general derangement, the kidneys are affected in a manner peculiar to themselves. Their mode of secretion is changed; and the urine assumes a particular character, which may be indefinitely varied.

Urine varies, in particular, in regard to quantity,

tity, according as the action of the kidneys is increased or diminished.

The numerous changes of colour, consistence, and smell, and the varied sediment which urine exhibits in diseases, have induced the vulgar to believe that the inspection of it may be of great utility in medical practice; and there have even been physicians who consulted the urine of their patients.

Changes in the nature and quantity of the urine only announce that there has been a change of action in the kidneys.

The urine generally assumes the same characters in similar affections; and the inspection of it may then assist the prognosis. But unless the physician be a good chemist, and examine it by reagents, it will be impossible, in such cases, to derive from it much benefit of importance.

There is one particular affection of the kidneys, in which these organs rapidly secrete an excessive quantity of urine (*diabetes*). All the nutritive juices are consumed in this way; and the patient becomes weakened as by a diarrhœa. This affection does not arise from a *relaxation* of the kidneys, as is generally believed; for an organ relaxed or debilitated does not perform its functions with more energy; but it arises from an increased action, a continued irritation in these organs.

Urine,

Urine, by freeing the blood from a quantity of aqueous parts which it contains in excess, takes from it also a great deal of other principles. The flow of urine, however, must not be considered as a *lixiviation*, during which acid, saline, and earthy substances are carried off; but rather as a real secretion, a peculiar organic operation, during which the greater part of the substances found in urine are formed. Thus uric acid, the presence of which forms the principal character of urine, is not found in the blood, but has been formed in the kidneys.

In proportion as the urine is secreted in the tissue of the kidneys, it exudes from the mammellous tubercles into the calices, by which they are enveloped: it is thence collected into small basons, from which it flows along the ureter, and is thus conveyed into the bladder.

The urine collected in the bladder gradually distends it. When this organ has acquired a certain degree of tension, it contracts; and by the simultaneous action of its sides and of the muscles of the abdomen and of the diaphragm, the resistance of its neck is overcome, and the urine is expelled with more or less force.

The bladder has been called the animal chamber-pot: it must not be imagined that the urine remains there as in a vessel; it is subjected to the continual action of the sides which contain it; these sides make an effort to digest it, and incessantly absorb

absorb its aqueous parts, on which account the urine in the morning is much thicker and more charged than when voided a little time after it has arrived in that organ. In regard to the urine of drink, of digestion, and of the blood, it may be readily conceived how erroneous all these distinctions are: there is only one kind of urine, that of the kidneys.

65. The arterial blood, in its circulation, distributes itself to the organs of motion, to those of the senses and of secretion, and carries thither the materials proper for the changes continually effected in all these parts. But it distributes itself also to some organs, with the use of which we are not yet acquainted: of this kind are the thyroid gland, the thymus, and the spleen.

The thyroid gland, larger and of a darker colour in children than in adults, in the female than in the male, is situated in the middle part of the neck, before the bottom of the larynx. It seems to be composed of an assemblage of lobes, divided into lobules: in the interior part it exhibits small vesicles, which contain a yellow viscous fluid. It is a swelling of this gland that produces the *goitre*. This affection, peculiar to women of certain countries, is the result of causes hitherto unknown.

The thymus is a glandulous body, situated behind



hind the sternum, between the two laminæ of the pleura. It is of a large size, flabby, and of a pale yellow colour in the foetus; it decreases, assumes more consistence, and acquires a darker colour with age; and in old age disappears entirely.

In the foetus, the thymus, composed of two lobes divided into lobules, exhibits in the inside an albuminous, whitish fluid, and has no apparent excretory ducts.

The spleen, situated in the left hypochondrium, is of a soft consistence, cellular, and has a blueish red colour: it receives a very large artery of the cœliac trunk.

The arterial blood, after distributing itself to every part of that organ, returns by veins which, by their union, forms a trunk that proceeds into the liver. Hence it appears that the use of the spleen is to give its blood to the liver, after it has undergone a change, which renders it analogous to the venal blood.

66. The blood, after being distributed to every point of the organization, and having thus discharged the functions peculiar to it, returns from all these points, in the state of venous blood and lymph, to repair its losses; to resume again the qualities of arterial blood, and to be fitted to serve for a new distribution.

The losses which the venous blood has sustained,  
during



during its distribution, are repaired by the product of digestion.

The chyle and the lymph, before they mix with the venous blood, begin to experience changes in their passage through the lymphatic glands; these fluids undergo a peculiar assimilation, and again acquire characters of animalization, which render them proper to form constituent parts of the organic substances.

The venous blood seems to return to the state of arterial blood, by freeing itself from some substances and by taking up others.

In its passage into the liver and the lungs it abandons those materials, by which it is constituted venous blood, and absorbs new principles in the respiratory organ.

A part of the venous blood, before it returns to the right side of the heart, passes through the liver. Thus the veins, which bring back the blood from the stomach, the intestines, the epiploon, the mesentery, the pancreas, and the spleen, unite into two trunks (*the splenic and meseraic*), which are soon confounded into one vein (*the sub-hepatic or vena-portæ*). This arterial vein, which is very large, penetrates into the liver towards the middle of its transverse scissure; the blood, which it carries thither, is distributed to every part of that voluminous organ, and disappears in the very fine divisions of the capillary ramusculi.

The

The venous blood, which traverses the viscera and the abdomen, and particularly the mesentery and the epiploon, is overcharged with a great deal of fat parts, from which it seems to be freed chiefly in the secretion of the liver. The liver by its action secretes the bile, which is evacuated by a peculiar order of vessels; and which proceeds into the duodenum, where it becomes one of the most powerful agents of digestion.

In the secretion of the bile, the blood is necessarily freed from the hydrogen and carbon of which that unctuous humour is composed; and by these means is disposed for resuming the qualities of arterial blood.

It is of so much importance to the organic order that the blood should free itself from the principles which form the bile, that when the secretion of this fluid cannot take place in the liver, in consequence of some peculiar affection of this organ, it appears that it is produced in other distant parts. Thus in the jaundice an analogous secretion of bile takes place in the kidneys, in the cellular tissue, and in the skin.

It is not, therefore, for the purpose of digestion alone that the bile is produced; because when it cannot be separated in the liver it is secreted somewhere else. In this case, the essential phenomenon always takes place; the blood abandons

dons the materials of the bile from which it was necessary it should be freed, and it is the accessory phenomenon, the peculiar use of the bile in digestion, which is for a moment impeded.

We have here another instance of the facility with which the organs can mutually supply the place of each other in their functions.

The humorists, according to their hypothesis, did not fail to ascribe the jaundice to bile conveyed into the blood ; but the folly of this assertion may be easily conceived.

If we suppose, that the bile secreted by the liver is absorbed by the lymphatic vessels of that organ, in order to proceed into the blood, it must first pass into the thoracic duct, then into the sub-clavian vein, then into the right side of the heart, then into the lungs, then into the left side of the heart, and thence into the aorta to be uniformly distributed by the arteries.

It is much more reasonable to think that the venous blood, not being able in the liver to abandon the materials of the bile, from which it ought to be freed before it passes into the lungs, deposits them in the cellular tissue of the different organs, where they are afterwards digested ; and that their elements are taken up by the lymphatics, or expelled by perspiration.

In acute diseases, where there is a general derangement,

rangement, the action of the liver, like that of the other organs, is interrupted. In this case, if the affection of the liver be of such a nature that its function is weakened or impeded, and if the secretion of the bile cannot take place in that organ, it will be separated elsewhere, and there will be symptoms of jaundice, which are not deserving of particular attention.

It results from these considerations, that the blood undergoes in the liver changes analogous to those which it experiences in the lungs; and that under this point of view the liver and the lungs are two organs which have analogous functions, as Fourcroy announced several years ago.

It evidently appears that the liver discharges the function of the lungs, in circumstances when respiration has very little activity; hence it is proportionally very large in the fœtus, which does not yet respire; it is in general very voluminous in reptiles and fishes, in which respiration is exceedingly slow; and it is exceedingly small in birds, which have the pulmonary organ very large and energetic.

In some cases of disease, such as phthisis, the liver sometimes becomes exceedingly voluminous and fat; but it is very doubtful whether its action be then increased: it is much more probable, that the swelling of this organ is a state of disease, during



during which the secretion of the bile is performed only with difficulty.

67. When the venous blood has undergone a first assimilation in its passage through the liver; as the lymph and the chyle do in traversing the lymphatic glands, it returns from all the parts by means of the veins, which unite into two large trunks: one of them brings back the blood from the lower parts (*the abdominal vena-cava*), and the other from the upper parts (*the thoracic vena-cava*). These two veins proceed to the right side of the heart with the small coronary vein; the blood penetrates into the right auricle and dilates it; when this auricle has acquired a certain degree of dilatation it contracts, and the blood passes into the ventricle, except that part which flows back. The blood accumulated in the right ventricle distends it also; the sides of this cavity contract, and force the blood into the pulmonary artery, from which it is expelled towards the lungs.

The blood cannot flow back from the ventricle to the auricle on account of a valve (*valvula tricuspis*), which opposes it; and it cannot return from the pulmonary artery to the ventricle, because it is prevented by the sygmoid valves.

It is to be remarked, in the motion of the heart, that



that the right auricle contracts at the same time as the left, and that the contraction of the two ventricles is effected at the same moment ; so that the motion of the auricles and ventricles takes place successively.

68. The blood which passes into the lungs is blackish, less warm (by two degrees), and a little heavier than arterial blood : it exhibits, therefore, the characters of venous blood.

The venous artery, which distributes this blood in the pulmonary organ, soon divides into two trunks, one for each lung. These arteries then separate into branches and rami : these rami into ramusculi much smaller, and the ramusculi subdivide into capillary vessels which elude the sight. The venous blood is thus dispersed throughout every part of the lung ; being reduced to a state of extreme tenuity, it undergoes there, during the act of respiration, certain changes, which make it resume all the qualities of arterial blood ; it becomes red, florid, spumous, warmer, and lighter. It then returns to the left side of the heart by veins, which arise from every part of the lungs ; which unite into rami and branches, and at last terminate in four large trunks, which proceed into the left auricle.

The blood passes thence into the ventricle of the same side, and into the aorta, from which it

is expelled by the arteries, to be again distributed to every part of the body.

69. The changes which the blood undergoes, in passing from the venous to the arterial state, take place in the interval between the moment when that fluid eludes our researches by the arteries, and that when we begin to see it return by the veins. It is in this infinitely small space, which our eyes, assisted by the best instruments, cannot penetrate, that the phænomena of respiration are effected.

It is proper here to remind the reader, that the lung, in its intimate structure, exhibits ramifications of the bronchic cavities. The air, which penetrates into this organ, enters by the mouth or the nostrils, passes through the aperture of the glottis, traverses the larynx and the trachea, and enters into all the divisions of the bronchiæ.

The bronchiæ must be considered as ærian vessels, which divide, in the interior of the pulmonary organ, into branches and rami; which are subdivided into capillary ramusculi of extreme fineness, and at length terminate in small cells, which communicate with each other. All these ærian passages are lined by a mucous membrane.

The arteries accompany the bronchic divisions, subdivide in the same manner, and expand on the sides of their cells; the veins arise from these  
sides,

sides, and in their passage follow also, in an inverse order, the divisions of the ærian passages.

The air enters into the cavities of the bronchiæ, and issues from them alternately during the movements of inspiration and expiration. Inspiration takes place by the dilatation of the sides of the breast and the depression of the diaphragm. The dilatation is effected by the action of the intercostal muscles, which carry forwards and towards the ribs, the sides of the breast, and particularly towards the bottom of them. During strong inspirations, this movement is assisted by the action of the muscles attached to the sides of the thorax, which extend to the bones of the neck, of the shoulder, and of the arm.

The diaphragm, which in its natural state is convex towards the breast, sinks down, becomes horizontal by the contraction of its muscular fibres, and increases the capacity of the thorax.

Expiration takes place by the mere relaxation of the muscles which contributed to dilate the breast; when the action of these muscles ceases, the parts resume their former state. Complete expiration is favoured by the contraction of the abdominal muscles, and particularly those which are attached to the bottom of the thorax. These muscles, in contracting, lower the breast, and compress the intestines, which depress again the diaphragm, in the interior part of the thorax.

During the dilatation of the cavity of the thorax, the lungs are distended; a sort of vacuity is formed in the bronchic cavities, and the external air immediately rushes into them. This air then issues by the depression of the sides of the thorax, and the relaxation of the diaphragm.

Respiration, when once begun, never ceases but with life; it is maintained by the action of the nerves, which distribute themselves to every part of the organ of respiration, and by the continual necessity which the blood has of experiencing the changes it undergoes by the function of the lungs.

The movements of the breast are such, that about eighteen inspirations take place in a minute.

From this short view of the movements of the breast and of the structure of the ærian cavities of the lungs, it may be readily conceived that the air, which penetrates into the bronchiæ, follows their ultimate divisions; and that when it reaches the last bronchic cells it must be almost in immediate contact with the blood.

It is now proper to examine the changes which the inspired air and the blood experience, in order that we may thence deduce the nature of the phenomena which must have taken place.

The atmospheric air inspired is composed of about four-fifths of azote and one fifth of oxygen.

The



The expired air contains almost the same quantity of azote, but it now retains no more than about the half of its oxygen, with a quantity of carbonic acid gas, less than that of the oxygen, which is wanting.

This important observation, for which we are indebted to the pneumatic chemistry, has given rise to various hypotheses.

The authors of the modern chemistry are of opinion, that the carbonic acid gas produced is formed in the lungs, by the combination of the carbon, disengaged from the blood, with the oxygen of the atmosphere; but I assured myself of the fallacy of this opinion by the following experiment. I placed some Guinea pigs under a bell glass, filled alternately with atmospheric air, oxygen gas, azotic gas, and hydrogen gas; and in all these cases there was nearly the same quantity of carbonic acid gas disengaged: its formation then is not owing to the presence of oxygen in the lungs.

Chemists have imagined also that a part of the oxygen inspired is combined, in the lungs, with the hydrogen disengaged from the blood; and that the water emitted, during expiration, in the state of vapour, is the result of their combination; but it is much more reasonable to suppose that this vapour expired, is secreted by the mu-



cous surfaces of the bronchic cells, like all the liquids which moisten the other organic surfaces.

The supposed formation of carbonic acid gas and water, by means of the oxygen of the air, the carbon, and the hydrogen of the blood, ought necessarily to be accompanied with a disengagement of caloric; and it is to this disengagement that animal heat and the habitual elevation of the temperature were ascribed; but the premises being erroneous, the consequence deduced from them must be erroneous also.

Chaussier has since proposed an opinion, which appears to be more probable. The carbonic acid gas, he says, is completely formed in the venous blood; it is only disengaged by expiration, and the oxygen gas is absorbed by the lymphatic vessels.

This assertion, much more agreeable to the common phænomena of the organization, appears to me, however, in one of its points, to require some modification. Experiments made with great care seem to shew, that this gas does not exist in the blood. Besides, it is a general observation, that the blood contains no products of secretion completely formed; it only possesses the principles of them which it assimilates in the organs of secretion.

Thus it is probable, that in the act of respiration,

tion, the blood frees itself from the constituent principles of the carbonic acid gas, in the *secretion* of that gas: as it frees itself from the constituent principles of the bile, in the secretion of that fluid. On the other hand, the lungs are a real organ of digestion: they assimilate oxygen gas, and probably a small quantity of azotic gas; these materials enter into the circulation, and serve for general nutrition and for the production of heat.

The caloric, which maintains the habitual temperament, and which is continually disengaged, seems to pass into the organization by the pulmonary organ, where it is absorbed with a portion of atmospheric air.

In the different classes of animals with lungs, it is indeed observed, that the animal heat follows the ratio of the extent and activity of the organ of respiration. Hence it is at the highest degree in birds; less in the mammalia, and very inconsiderable in reptiles.

The blood which proceeds to the lungs has a blackish colour; and it returns from that organ with a beautiful red tint. Chemists ascribe the beautiful red colour of the arterial blood to the absorption of oxygen; because the venous blood becomes red when in contact with that gas; but it assumes the same colour by warmth, and ani-

mals reduced to a state of asphyxia, by carbonic acid gas and the gaseous oxide of carbon, have very red blood also.

It is probable that the venous blood loses its blackish colour in the lungs, by freeing itself from those principles which form carbonic acid gas. But, however this may be, a difference of colour is, in general, a matter of very little importance. It is well known, that different arrangements of the same molecularæ of a body are sufficient to produce changes, exceedingly various, in the reflection of the luminous rays, and consequently in its coloration. We know that the arterial blood is redder, more spumous, and warmer than the venous blood; but chemical analysis shews no essential difference between these two kinds of blood, in regard to their composition.

70. When respiration has been suddenly suspended, death takes place in a few minutes. It was natural, therefore, that attempts should be made to account for this extraordinary phænomenon.

Chemists have supposed, that as the absorption of oxygen by the blood is the principal phænomenon of respiration, death ensues when this absorption cannot take place; because the blood, being deprived of its habitual stimulant, can no longer

longer excite, in a proper manner, the left ventricle of the heart, which then ceases to contract.

But, in the different kinds of asphyxia, it is observed, in general, that the aortic ventricle is always empty, while the pulmonary ventricle is full; which evidently proves, that the left side of the heart did not cease to contract till it ceased to receive blood.

On the other hand, Guinea pigs exposed to azotic gas, and very pure hydrogen gas, live a considerable time, and their death seems to be occasioned, in part, by the presence of the carbonic acid gas expectorated; so that the want of oxygen, in respiration, does not become fatal so speedily as has been supposed.

Asphyxiæ may be distinguished into three sorts: 1st. Those which take place in consequence of the entrance of air into the lungs being suddenly intercepted: 2d. Those which take place when the lungs, instead of receiving atmospheric air, receive a foreign gas, which however exercises no pernicious action: 3d. Those which result from the introduction into the air-passages of any substance which exercises a speedy and fatal action.

Asphyxiæ, which take place in consequence of the air being prevented from entering the lungs, are those which result from the different modes of strangulation, suffocation, and submersion. It is probable



probable that in all these cases death ensues, because the play of the lungs is necessary to promote the circulation of the blood, the whole of which passes through that organ : respiration being suddenly suspended, circulation may be prevented ; and death, which at first is only apparent, soon becomes real, if speedy relief be not applied. Death, in all probability, takes place so soon, merely because the organization has not time to accommodate itself to so great and so abrupt a derangement. It is well known that divers gradually habituate themselves to remain under water for a longer time than is sufficient to drown some persons completely.

When an animal is immersed in very pure azotic or hydrogen gas, the play of respiration is not suspended ; inspiration and expiration continue to take place ; circulation is not interrupted, and life continues. The lungs, however, are deprived of their habitual aliment ; and when this privation is sudden, and continues too long, the animal at length perishes. But, if it be slowly habituated to respire in one of these gases, and if care be taken to absorb the carbonic acid gas expectorated, the reaction of which on the lungs is so fatal, it may readily be conceived that the privation of oxygen gas may be endured for a very considerable time. Azotic and hydrogen gas, therefore, do not kill,  
but



but suffer the animal to die slowly, because they merely maintain the play of respiration, without supplying the aliment necessary for life.

The asphyxiæ which take place in consequence of deleterious substances conveyed into the lungs are the most numerous. They are those occasioned by the inspiration of the carbonic acid gas, disengaged from wine or beer casks in a state of fermentation, from lime-kilns, &c.; by the inspiration of the carbonated hydrogen gas produced by charcoal, when it begins to burn with a slightly blueish flame, and by the inspiration of the vapours exhaled under certain circumstances from privies, drains, burying grounds, &c. These substances, conveyed into the lungs with the inspired air, produce, sometimes, on the nerves of that part, an impression sufficiently violent to occasion a general derangement of the nervous action and sudden death. These asphyxiæ exhibit a phænomenon analogous to poisoning, by those substances called narcotics.

When the deleterious substances conveyed into the lungs are not sufficiently strong to produce asphyxia, they may give rise to a highly varied series of morbidic phænomena. Thus the greater part of epidemic fevers seem to be produced by emanations from vegetable or animal substances, in a state of putrefaction, conveyed into the lungs,  
and

and especially of individuals who have a disposition suited to them. In the plague, these substances introduced in a larger quantity into these organs of a weak individual, already altered by fear and despair, may produce sudden death; as has been observed in all cases where the plague has been epidemical. Death, on such occasions, is a real asphyxia.

71. The venous blood, after passing through the lungs, and having resumed there the qualities of arterial blood, proceeds into the left side of the heart by four large veins, which deposits it in the auricle, whence it passes into the ventricle, and thence into the aorta, to be again distributed to all the organs by means of the arteries.

The atmospheric air inspired, after remaining in the lungs, and losing there a part of its oxygen, and perhaps a small quantity of azote, is in part expelled at each expiration along with the carbonic acid gas which has been excreted.

But air which enters and continually issues through a narrow aperture, furnished with a moveable appendage, and which may be driven with greater or less force into a cavity where the sound produced is modified before it issues from it, furnishes all the conditions necessary for a wind instrument. Thus the air, after conveying into  
the

the lungs one of the principal aliments of life and the source of heat, may in its return receive a vibratory movement, which is transmitted to a distance; and, in the formation of the voice, constitutes an artificial sign exceedingly proper for the improvement of the mind, and the means which have the greatest tendency to unite men in the bonds of society.

The vocal organ is an apparatus, the function of which is difficult to be understood; and the physiologist who hears the harmonious sounds which proceed from some throats, is much more astonished by the difficulty overcome, than by the effect produced; for it is perhaps hardly possible to conceive an instrument more refractory than the vocal organ of man. But this proves how far the parts of the body, by their surprising flexibility, can overcome the greatest difficulties, and surmount every obstacle.

The simplest and most perfect vocal organ is, no doubt, that of birds. These animals, at the union of the bronchiæ, on the sides of the lower part of their trachea, have two membranous folds, which in part close the aperture of the latter. The air expelled from the lungs makes these membranes vibrate; their vibrations are communicated to the air, and a sound is thus produced. This *inferior larynx* is, for the most part, furnished

nished with small muscles, susceptible of causing a variation in its movements. The trachea, which consists of very fine cartilaginous rings united by a membrane, is capable of being lengthened or shortened.

In the last place, the superior larynx has an aperture susceptible of contracting or dilating, so that the vocal organ of these animals is a wind instrument, entirely analogous to those of the order of horns; its mouth is towards the lungs\*.

If the theory of stringed instruments be applied to this wind instrument, according to the method of Euler, it may be subjected to calculation; and the length of the string, its degree of tension, and its vibrating force, may be appreciated.

The length of the string is measured by that of the trachea; its degree of tension by the aperture of the superior larynx; and the vibrating force by the expulsion of air from the lungs.

In man, the vocal organ exhibits another arrangement; there is no larynx at the bottom of the trachea; the air expelled from the lungs by the bronchiæ traverses the trachea, as in a conducting tube, and at its passage through the larynx meets with the epiglottis. This moveable cartilage, when struck with force, vibrates, and

\* See the Memoir of C. Cuvier.



makes the surrounding air enter into a state of vibration also. The sound, therefore, is only produced on its issuing from the larynx, and is afterwards modified in its passage through the mouth and nostrils.

To judge of the value of the vocal organ in its natural state, and of the quality of its tone, nothing is necessary but to hear the cries of an infant; and when we reflect that means have been devised to produce from this instrument the most harmonious sounds, it is hardly possible to conceive how so great a difficulty could be overcome.

The sounds produced at the aperture of the larynx, when accented by the different parts of the mouth, form *speech*, and modulated sounds constitute *singing*.

The vocal organ of man, though attended with less advantage than that of birds, exhibits an analogous structure, and may be referred also to the theory of stringed instruments.

The length of the cord is measured by the distance comprehended between the aperture of the glottis and that of the mouth or nostrils; this length may be varied by the elevation or depression of the larynx, and even by the position of the lips.

The vibrating force depends on that of the  
lungs,



lungs, by which the air is expelled; and the degree of tension on the variable aperture of the mouth.

Though the vocal organ of man be a wind instrument, not very advantageous, it affords a great many resources in regard to its improvement; thus the sound produced, on the air issuing from the larynx, may pass from grave to acute, according as the aperture of the glottis is greater or smaller; as the larynx is depressed or elevated, and the neck more or less elongated; and according as the mouth is more or less open. Sound, when once formed, may be modified a great many ways, by the varied movements of the tongue, the cheeks, the teeth, the lips, &c., and by its passage through the nostrils. Sounds, according as they have been modified by any of these organs, are distinguished by the names of labial, dento-lingual, palato-lingual, &c. articulations, &c. (See *Lexicographie de Butet.*)

Man has employed the sound which may be produced by air expired with velocity as a conventional sign, merely because pain obliged him to emit cries, which induced him to think that he might render these cries of utility; for if the air, in issuing from the lungs, had not been accompanied with sound, he would have remained as dumb as a person born deaf.

When

When children hurry too much in the accentuation of sounds, they repeat the same syllables several times, which is called stammering. This defect, when not of too long standing, may be corrected, by making the child acquire a habit of pronouncing each syllable distinctly, one after the other.

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## ACTION OF THE ORGANS OF RE- PRODUCTION.

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72. **EVERY** organized being is produced by another similar to it, and from which it is separated, after having formed a part of it.

Organized beings, whose mode of reproduction is known, exhibit two ways by which they may completely attain to this function.

When a part of an organized being is susceptible of being detached from it to form a similar being, this mode of reproduction is called that by slips; thus the germs of some plants detach themselves from the stem, and being received in the earth, produce other plants, as is the case with the ornithogalus. Some bulbous plants produce small bulbs, which increase, send forth roots, and detach themselves from the parent bulb to form new ones. Polypes send out gems from every part of their bodies, which increase in size, detach themselves, and form entire polypes. The last articulation of the naides increases and detaches itself to form a perfect animal.

For the same reason, we ought to be able to divide an organized being into several parts susceptible

ceptible of reproducing itself, provided each of them contains a bud or germ. Thus a twig detached from the root of a tree may produce another tree, provided this twig contains a bud. A polype may be cut into a great number of parts, which produce entire polypes.

But what appears to be very extraordinary is, that a worm which has a head, a trunk, and a tail, all very distinct, should be susceptible of division into several pieces, capable of reproducing the parts which are wanting to them; though in this animal the head contains a cerebral system, and though the apparatus of generation is insulated.

73. The seeds and the ova, like the buds and germs, are small bodies which detach themselves, and by their development produce beings similar to those from which they proceeded; but they differ from them in this respect, that they have need of being previously *fecundated*. Living beings, which multiply by slips, reproduce themselves also from seeds and from ova.

The individual which bears the seed or the egg may also bear the fecundating organ; or these two organs may be in separate individuals.

The union, in the same individual, of the seed or the ovum, and the organ proper for fecundating it, constitutes hermaphroditism. The separation

of them in two distinct individuals establishes difference of sex.

The greater number of vegetables are hermaphrodites. The male parts may be united in the same flower with the female parts, or both these parts may be found in separate flowers.

Most shell animals are hermaphrodites; the eggs are fecundated by the male organ, in descending along the oviduct. Some of these animals, though provided with male and female organs, have still need of copulation; of this kind are the snail and the slug. It does not, however, appear that in the copulation of these animals the male organ of the one can serve to fecundate the egg of the other; there is more reason to think that their copulation is a stimulant proper for favouring their individual fecundation.

74. The seeds and the eggs are composed of the germ, and the nutritive apparatus which is destined to promote its first development.

In plants and the greater number of animals, the nutritive apparatus, which envelops the germ, is supplied, at the expense of the mother, with a quantity of nutritive substance sufficient for its first increase, and for enabling it to break the shell, in order to live by its own strength.

In the mammalia, the nutritive apparatus is fixed to the sides of the matrix, and draws from it



it juices which it assimilates and distributes to the embryo.

The ovarium must have acquired its complete development, before the seeds or the eggs, which it contains, can be susceptible of fecundation.

The seeds or the eggs may detach themselves from the ovarium before or after their fecundation.

The eggs detached from the ovarium, before fecundation, may be afterwards fecundated, or may not be susceptible of it.

Some seeds ripen without having been fecundated; but they remain barren.

The eggs of birds often come to maturity without having been fecundated, and in that case are no longer susceptible of it\*.

In all these cases, the nutritive apparatus assumes a proper increase at the expense of the mother, in order to serve for the nutrition of the germ, whether the latter is to be developed or not.

The ova separated and ejected from the ovarium of certain osseous fishes may be fecundated; and those of several reptiles, such as frogs, are covered by a thin pellicle, and readily putrefy.

\* It is probable that when these seeds or eggs have acquired their full increase before fecundation, the thick strong covering which surrounds the germ is an obstacle to their future fecundation.

The liquor of the male organ suspends this putrefaction, even when in an advanced state, and can also produce fecundation.

76. Though the presence of the organ of generation in the male and in the female is not necessary to the life of the individuals, and though these organs appear, as we may say, to have been superadded, they exercise a very striking influence on the whole of the organization, as is observed by the difference which exists between individuals provided with these organs and those which are deprived of them.

In organized beings, which exhibit two different sexes, the act of fecundation is performed by a complex apparatus of organs; life is exalted, acquires more energy, and seems to be prepared as for an important act. All the powers are directed to and concentrated in the generating organs; and after fecundation the individuals experience a manifest state of languor. The male seems to have made the greatest effort, and shews a more remarkable depression; but at that period his task is finished, and a new one begins for the female.

Some plants, such as pinks and the lychnis, when forced to sterility, live longer and resist the cold better.

Butterflies

Butterflies exist under the winged form, only in order to reproduce themselves, and after satisfying this law they soon die.

In order that some animals may fatten, they are deprived of the essential organs of generation.

76. The male, of almost all animals which copulate, places himself on the back of the female during coition; in some, however, there are certain dispositions, such as a broad thick tail, which prevent this mode of copulation: the female of the hedge-hog and porcupine places herself on her back. This mode of copulation is that of cetaceous animals, the rays, squali, and the crocodile. The female elephant only bends her fore legs; the ostrich lies down on its belly; serpents entwine themselves with each other, &c. Some reptiles, such as toads, adhere so strongly to the female, that they will rather suffer themselves to be torn than to separate from them.

Insects almost always exhibit in their fore claws the means proper for keeping themselves fixed on the female; and the females also have frequently hooks by which they lay hold of the male during their long copulation. The duration of this act varies in the different classes: in birds it scarcely continues a few seconds; it is longer among the mammalia, and particularly those which have no

feminal vessel, as is the case with the dog; in the last place, it is excessively long among some reptiles, such as frogs, which continue in a state of copulation even forty days.

“All organized beings continually reproduce themselves in this manner, amidst languor and transports of pleasure.”

77. Among the mammalia, the first period of conception is indeed very obscure; but generation has been too much considered as a *mystery*. This phænomenon is no more obscure, and perhaps is less so than many others that take place in organs, the smallness or transparency of which makes them elude all our means of observation.

In reproduction by slips, the action of life is continued without interruption, from one race to another, by means of buds or germs. These are small bodies, which by their spontaneous development produce beings similar to those from which they detach themselves.

In reproduction, by means of semen or ova, the germs contained in these small bodies attain only to a certain degree of development by the influence of the vital action of the mother; and whether they remain attached to her, or are deposited, they acquire no further increase. But if at that period they receive the fecundating impression of the product of the male organ, they again enter  
into



into action; the semen and ova are then exactly in the same situation as buds and germs: they exhibit different ways which lead to the same end, and which produce the same results.

78. In what manner does the prolific substance vivify the germ? And what takes place at the moment of conception?

This phænomenon is not, as some philosophers imagine, above human comprehension; but merely below the reach of our sight; and we can form no judgment but of things which strike some of our senses.

If one of the animalcula of the semen could come and tell us what is observed in the ovarium at the moment of fecundation, and during the first days of gestation, it would relate a series of facts, which certainly would not exceed the limits of the human comprehension; but our coarse eyes cannot perceive the hundredth part of a line, while there are organized beings, much smaller, which are endowed with the powers of perception, digestion, and reproduction. As we have no data, therefore, in regard to these first phænomena, we shall not attempt to give any explanation of them.

79. Was it necessary that the whole series of beings, past and to come, should exist in the first seeds



feeds and the first ova? One might as well ask, whether the small vegetables, which scarcely cover the naked sides of a chain of mountains, contain within them the immense forest which is to exist there a thousand years after; or, whether all the flames by which Troy was consumed existed in the first spark struck from a piece of flint? In all these phenomena we ought to see only a continuity of action.

80. The germs contained in seeds and in ova, when once fecundated by coming into contact with the secretion of the male organ, develop themselves afterwards by means of a nutritive apparatus furnished by the female. This apparatus exhibits numerous varieties, in the different classes of living beings. It, however, always consists of a vascular and membranous reticulation, which affords the means of circulation between it and the germ. These two systems are so connected that it can hardly be conceived how they could have been separated. This arrangement is one of the strongest proofs of the pre-existence of the germs in the female. The nutritive apparatus of the germ is developed by a continuity of the vital action of the mother.

In oviparous animals, properly so called, this apparatus may acquire its full expansion, whether the germ is to be developed or not: it then detaches

detaches itself from the mother, to serve for the further development of the fecundated germ.

In vegetables this apparatus does not, in general, attain to maturity till after the fecundation of the germ; it then detaches itself, and serves for the same purpose as in the preceding case.

Among the mammalia, the nutritive apparatus is not developed till after conception; and does not serve for the increase of the embryo, but so far as it remains attached to the mother.

In all cases a circulation is established between the embryo and the nutritive apparatus, by the new vital action which the germ receives at the moment of fecundation.

81. The nutritive apparatus of the seed consists essentially of one or two cotyledons, which are continued with the germ. The cotyledons, for the most part, are surrounded by a perisperma, which furnishes them with the first materials of nutrition. The whole is enclosed in a triple covering.

After fecundation, the germ and the cotyledons expand and increase in the same proportion. The cotyledons derive from the perisperma the first nutritive juices; the covering of the seed then bursts; the cotyledons increase in size, and acquire from the earth and the air other alimentary substances, which they continue to assimilate and

to

to distribute to the embryo. The radiculæ and plumula are then seen gradually to develop themselves; and when the small plant is in a state capable of appropriating to itself the nutritive moleculæ suited to it, the cotyledons wither and detach themselves.

82. The nutritive apparatus of the ovum of birds exists chiefly in the membrane of the yolk, which is continued with the intestines of the embryo. This membrane gradually absorbs the white substance of the egg, which passes through the yolk; it then absorbs the yellow fluid itself; assimilates these materials, and transmits them to the embryo to serve for its first increase.

In this mode of growth, the nutritive apparatus is diminished in proportion as the animal increases. When the latter has acquired a certain degree of strength, it makes a continued vertical motion with its head; breaks in this manner its shell, by means of a small, sharp, and very hard body which is above its beak; and at length issues forth, to enjoy a new life.

As the bird, freed from its shell, is as yet incapable of providing for its wants, it is not abandoned by its mother. The latter begins to nourish it with a whitish liquor secreted from her crop; she then supplies it with more nutritive aliments, of which she goes in search. When the young  
animal

animal is strong enough to make use of its wings, it deserts its mother, and seeks for its nourishment wherever it can.

Among birds, it is observed, in general, that the male which has fecundated the ova does not abandon the female, and participates in the care of educating the young; he assists in the construction of the nest; sits on the eggs in the absence of the female, and brings nourishment to the young. When the education is finished, the male and female separate, and the next season form new connections.

Though the development of the ova among reptiles, fishes, and animals, without vertebræ, has not been observed with the same care, every thing seems to announce that it takes place, in general, in a manner analogous to that of the ova of birds.

83. Seeds and ova, in order to be developed, require to be placed in atmospheres at different degrees of heat, moisture, and perhaps of electricity.

The ova of fishes and serpents are developed at the usual temperature of the climates where they exist. Those of some insects, such as the silk-worm, require a slight heat; and those of birds require a heat at least of 85 degrees.

The seeds of all vegetables, and the ova of some microscopic animals, require heat and moisture.

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The life of some small vegetables, and of certain microscopic animals, which requires the continual presence of humidity, may, when deprived of it, be suspended for a period, often of considerable length, and it may resume its activity when humidity is restored to them, as is observed in the conservæ and the wheel insects.

Seeds and ova, which are developed only at a certain degree of heat, can often be preserved for a long time, and even a great number of years; and again enter into action when subjected to that temperament which is suited to them.

This disposition may serve to account for the sudden appearance, as is often the case, of a great number of insects and small vegetables, in places where the presence of organized beings was not suspected.

84. Among reptiles with a naked skin, and the greater part of insects, the animal which begins to develop itself has no resemblance to that which gave it life: it exhibits a different form, and other systems of organs. Thus the tadpoles of most aquatic reptiles lose their branchiæ, their tail, and their whole skin; acquire four legs; respire by means of lungs; and at length exhibit an animal entirely different, which succeeds the first.

Insects, brought forth under the form of caterpillars, pass afterwards to the state of chrysalide; and



and at length expand into a butterfly. This animal, indeed, exhibits all the parts proper for undergoing these metamorphoses; and it appears as if three different animals were developed in succession. The organs of generation are observed only in the state of butterfly.

85. The nutritive apparatus of the germ of the mammalia consists, like that of seeds, in one or more cotyledons. These organs remain attached to the uterus, and derive from it juices which they assimilate for their development, and for that of the embryo.

In this apparatus, as in that of birds, the germ is immersed in a secreted fluid, and retained by a membrane, *amnios*.

In the last place, this apparatus does not essentially differ from that of seeds and ova, but by being attached to the uterus.

86. At the moment of fecundation, the tube enters into a sort of erection, and its wide end is applied to a part of the ovarium. This organ exhibits then, in that part, a small tumour, which increases and gradually swells up.

This tumour seems to contain only a mucous matter, first whitish and then of a reddish yellow colour; it afterwards sinks down, and the ovarium retains a small scar. During the first days of conception,

ception, nothing is observed in the tube but a shapeless mass of mucous matter, which gradually increases, and is conveyed into the matrix, where it acquires more volume; and which, after a period of greater or less duration, suffers its different parts to be distinguished.

87. The function of the cotyledons or placenta is to draw off from the mother the nutritive juices which serve for their increase and for that of the foetus, by means of the circulation which is established between them.

The blood, which proceeds to the foetus, seems to undergo, in its passage through the placenta, changes analogous to those which it experiences in its passage through the liver or the lungs of adults: it resumes there new vital properties.

When the placenta has acquired a certain increase or sort of maturity, and when the foetus is sufficiently strong to be able to respire, the matrix violently, distended experiences pains, which forces it to contract and to expel both.

Among the mammalia, the young animal, when it issues from the matrix, remains attached to the mother by the need of lactation; and the mother herself is excited to empty her dugs, and bestow care and attention on her young.

88. During gestation, the dugs swell and become

come sensible. Some days after parturition, a new mode of action takes place in these organs; secretion of milk is established, and continues in consequence of the animal being suckled.

89. The teats differ both in regard to their number and position, in the different classes of animals: in the bat, elephant, and apes, they are in the breast; in most quadrupeds on the abdomen; in cetaceous animals on the sides of the anus, &c.

The teats are at least two in number: ruminating animals have four, and the sow has even fourteen.

90. All the mammalia, as well as the other classes of animals, find themselves urged, at certain periods, by a desire of reproducing themselves; their genital parts are then more voluminous, and they experience a sort of turgescence: it is observed also that some females have a running, sometimes of a reddish colour, from the vagina.

Among most of the mammalia, the male remains very little attached to the female after copulation. It is however observed that the carnivorous species, which experience the greatest difficulty in procuring their nourishment, continue longer united; and among these species the males

even often participate in the first cares bestowed on the education of the young.

91. Organized beings, in general, reproduce themselves only by means of individuals of the same species: it is however not uncommon to see different species copulate and produce young. This bastard fecundation takes place, for the most part, among species which approach nearest to the same genus; and the individuals resulting from it, in the vegetable kingdom, are distinguished by the name of *hybrides*; and in the animal, by that of *mules*. Individuals produced by the copulation of different varieties, in the same species, are called *mestese*.

It is very often remarked that *hybrides*, *mules*, and *mestese*, are stronger than the individuals which produced them; and this circumstance has shown the advantage of crossing the breed.

Hybrid plants are fruitful and multiply their varieties. Several botanists, however, assert that the germinating property of seeds which arise from hybrid plants does not extend beyond the second generation.

Mules, among birds, are generally capable of reproduction. Among the mammalia, they lose this property, and remain barren.

Mestese reproduce themselves, with the peculiar characters of their variety.

Hybrides,



Hybrides, mules, and mestise, generally have a resemblance to the mother in their interior and fundamental parts; and to the male in their exterior and accessory parts; which tends to prove, that the germs pre-existed in the female, and that the male, by fecundating them, could only modify them superficially.

Every peculiarity of structure, every defect of conformation, and even every organic disposition or aptitude for certain faculties, is susceptible of being at length transmitted by the way of generation. It is in consequence of this property that the same forms and the same qualities are preserved in plants, and in several races of animals, as dogs and horses; and that certain organic maladies are perpetuated, such as the bunch of the elephant, &c.

The crossing of breeds, especially if the most beautiful females be chosen for that purpose, is the best means to correct, in the speediest manner possible, essential organic defects, and to obtain races stronger and more beautiful.

Culture or education, by which organized beings are continually modified, and generation which tends to propagate the changes produced, are the two means which may powerfully concur towards the improvement, as well as the degradation of species, according to the manner in which they are directed.



92. What has been said, in general, on the reproduction of all organized beings, and on that of the mammalia in particular, is applicable to the human species. In the examination, therefore, of that function, we shall take notice only of the principal facts which seem more particularly to demand our attention.

The period of puberty is announced, in both sexes, by very remarkable changes: in girls who have attained to the age of 14 or 15, or sooner or later according to the climate, it is observed that the giddiness and liveliness of early youth decrease, and that they become more thoughtful. The bosom begins to swell, and gradually acquires a greater volume; the pubis is covered with down; the pelvis completing its expansion, assumes its proper form, and menstruation commences.

In boys, the period of puberty takes place two or three years later; they become less boisterous, and acquire a more serious turn; the voice passes from acute to grave, and becomes an octave lower; the quality of the tone often entirely changes; the genitals are covered with hair, and experience a sort of instantaneous and painful turgescence.

Man is irresistibly urged to reproduction, as well as to self-preservation, by the painful sensation of need; and the pleasure he experiences in satisfying

fyng that need induces him to repeat often the act of reproduction.

If young persons of a strong constitution, uninformed, and who live in a state of idleness, be carefully observed at the epoch of puberty, when the organs of reproduction begin to acquire their full development, it will be found that they experience a sort of transient languor, dejection, and exaltation; this state is continually renewed, and soon becomes very painful. They experience in the genitals a sort of heat and uneasy pruritus, which obliges them to fix their attention on this system of organs; this uneasiness, which becomes more and more insupportable, induces the sexes to approach each other, and the painful state which they experience, and which they naturally wish to get rid of, conducts them at length to the act of reproduction.

In the human species, it is not observed that the desire of reproduction is renewed at certain periods.

It is however probable that this peculiarity is a result of civilization; that in the state of nature there are some periods more striking in this respect, and that, in women, they correspond with those of menstruation.

93. According to numerous experiments and observations made by Haller and others on animals, for the purpose of throwing more light on

the phænomenon of reproduction, it results that, during copulation, the uterine tube experiences a sort of erection, and that the broad end of it is applied to the ovarium.

It is probable that in this state the prolific fluid proceeds to the ovarium, traversing the uterus and the tube, and that it effects the fecundation of one or more germs, contained in the small vesicles corresponding to the part of the ovarium to which the wide end of the tube is applied.

The quantity of sperm necessary to effect fecundation must be infinitely small; for under some favourable circumstances the vapour or even odour of that substance, conveyed into the ovarium, seems to be sufficient to communicate to the germs a vital movement.

Some days after conception it is observed, that one of the vesicles of the ovarium swells; it then bursts, and the viscous fluid it contained enters the tube. The cicatrix resulting from this rupture is gradually formed, and always leaves a sort of tubercle with a yellow spot.

The cicatrix and the yellow spot indicate, in general, that fecundation has taken place. These signs, however, are observed sometimes in young women, who have remained barren. Swammerdam ascribes this phænomenon to sterile caresses or solitary enjoyments: this stimulus of pleasure must make the germ burst its first covering and  
enter

enter the tube, where it soon withers, in consequence of not having received the impresson of its specific irritant.

The germ which enters the tube, and which as yet appears under the form of a mucous body, descends along the tube, and proceeds into the uterus, where it remains and acquires development.

Sometimes the fecundated germ, instead of entering the tube, descends into the abdomen and there expands: the germs have been found also to develop themselves sometimes in the ovarium, or in the uterine tube; and in all these cases parturition, by the usual passages, becomes impossible.

The development of the foetus appears at first to be slow; but it seems afterwards to increase in the ratio of the volume which it acquires. At the end of the first month, it is scarcely a few lines in length; but towards the end of the second it is nearly two inches; at three months it is three or four; at four months five or six; at five months six or seven; at six months eight or nine; at seven months nearly half a foot; at eight months from fourteen to fifteen inches; and at the period of birth it is eighteen inches. All these dimensions, however, are liable to much variation.

The chorion, which at first has a cottony appearance, the amnios which secretes and contains the liquid in which the embryo floats, the placenta



which is attached to the sides of the uterus to extract juices from it, the umbilical cord which establishes a communication between the foetus and the placenta, all expand simultaneously, and increase in the same proportion as the foetus.

As the embryo develops itself, the parts which compose it can be distinguished. Thus when it is nearly an inch in length the head forms the half of its volume; the eyes are marked by two black points, and the place of the mouth is indicated by a broad transverse fissure; the four limbs arise from a small short trunk, and are very near each other; but as it increases, the form of the parts is better defined, and they gradually approach that type which they are destined to retain.

When the foetus has acquired a certain size, and the placenta has attained to a sort of maturity, the uterus which is strongly distended contracts; and by a simultaneous action of that organ, of the diaphragm, and of the muscles of the abdomen, the child bursts its coverings, and issues, in general, with the head foremost, and the face towards the sacrum. After it comes forth, the uterus, which still continues to contract, expels the placenta and its appendages.

After delivery, the uterus slowly returns to its former state; its sides decrease in thickness; during its contraction it excretes a liquid at first sanguinolent and then serous, which gradually diminishes;



nishes; and this organ by little and little is restored to its former condition.

94. But towards the breasts another series of phænomena, no less important, soon takes place. These organs, which during gestation remained in a sort of continued turgescence, swell up, become painful, and a secretion of milk begins to be established.

The relation which exists between the uterus and the breasts can be explained neither by the distribution of the nerves nor by that of the vessels. These organs, in their respective functions, tend towards the same end; that is, the nourishment of the child. This common property renders them dependent on each other, and when they enter into action, causes them to have a reciprocal influence.

The arteries distributed to the breasts furnish the materials necessary for the secretion of the milk. There is no sufficient reason for believing that the organization here follows its habitual course, and that this fluid arises from the chyle.

At the period of lactation the breasts swell; the arteries are dilated, and easily supply the quantity of blood necessary for the secretion of the milk; and the materials which have not been employed for that secretion return by the sanguiferous veins and the lymphatic vessels, the latter of which are exceedingly

exceedingly numerous, as in all the secretory organs.

On the second or third day after delivery, the secretion of the milk is completely established. This new function is announced by a general change of state, a sort of febrile crisis, more remarkable in women of a weak constitution.

The secretion of the milk, in general, takes place spontaneously; but the greater part of this fluid is secreted while the child sucks.

That the milk may be secreted in abundance and with facility, the mother must be placed in a particular and habitual situation; she must have an affection for the child; and the latter must have acquired the habit of stimulating the breast by a proper mode of sucking\*.

When a nurse prepares to suckle the child, she sometimes experiences in the breasts a sort of orgasm or turgescence; and she has a sensation as if something were proceeding towards them, which induces her to say that the milk ascends.

In young women, and even in men, a secretion of a sort of serous matter, more or less abundant, but which does not exhibit the qualities of good milk, has been sometimes produced in the breasts by repeated sucking. The quantity of milk secreted is not proportioned to the size of the breasts,

\* See Borden, *Traité des Glandes*.

but to the vital energy of the gland which effects the secretion.

The best milk is that furnished by a healthy nurse of a gentle disposition, who leads a tranquil life and uses proper food.

All sudden derangements which take place in the organization, produce changes in the quality of the milk. Whenever the secretion of the breasts is disturbed by any cause whatever, it is observed that its product becomes aqueous, and that it acquires a stimulating property, often very remarkable, on the digestive organs of the child: the latter then experiences colics, or is seized with purging.

I have often had occasion to remark, that when the function of a secretory organ is deranged, its product exhibits stimulating properties of greater or less strength.

Several physicians have imagined that the purgative property of certain medicines is conveyed from the mother to the child, because the latter is sometimes purged when the nurse takes any laxative substance; but this phenomenon arises merely from the secretion of the milk being disturbed in consequence of the general derangement produced by the purgative. The child may be purged when the mother has experienced great fatigue, a violent fit of passion, or any cause of derangement

ment whatever. The child is the more sensible to the different alterations of the milk, the weaker and more irritable it is; but when robust, and when its gastric organs are in a good state, it is not easily affected by the changes which may take place in the quality of that fluid.

The secretion of the breasts is disturbed also when the uterus experiences a new mode of action. It frequently happens that a strong nurse, of a sanguine temperament, experiences the menstrual flux during lactation: it is then first observed that the milk flows more abundantly; that it is clearer, and that it produces an irritating action in the digestive apparatus of the child: but this effect is only momentary, and the milk soon resumes its former qualities.

When a nurse becomes pregnant, her milk is at first somewhat turbid; but it soon returns to its former state; it is only observed that it decreases in quantity as gestation advances, so that a nurse may, without inconvenience, continue to suckle during her pregnancy, as long as she is able to undergo the labour without fatigue.

When any considerable derangement is produced in the organization, or in the nervous action, or when a febrile state takes place, the breasts sink down, and the secretion of the milk is often suddenly suspended.



95. Philosophers have at all times made researches to ascertain whether the human race has descended from one species, or whether there were originally several; and if this was the case, of what kind they were. It is probable, that a great deal will be written on this question, before it be resolved. I shall therefore only offer a few reflections on the subject, which will serve to give the reader some idea of what nature it is.

The classification of organized beings is not a matter of abstraction and convention: orders and genera exist for plants, independently of all system and method, in what botanists call the natural families; and the greater number of vegetables are arranged in these families.

Naturalists ought to enter into an agreement to comprehend, under the denomination of *genus*, all individuals *susceptible of copulation and reproduction*, as the etymology of the word seems to indicate. There could then be no dispute in regard to the signification of this term, since it would only be the expression of a fact which might easily be verified.

The individuals of a genus, which exhibit particular characters, and which are susceptible of being preserved by means of generation, compose a species.

When individuals of two species of the same  
genus



genus copulate, the result may be a product without a perfect resemblance either to the father or to the mother, and having new characters. If these characters are preserved by generation, the individuals which exhibit them constitute a new species. On the other hand, if they be effaced, and if the individuals of the second race resume the characters peculiar to the first progenitors, they are called varieties, or *meteste*. In the last place, when the products of two different species cannot be perpetuated they are called *hybrides* or *mules*. Thus man, in regard to the colour of the skin, exhibits three distinct species (the white, the yellow, and the black), susceptible of being preserved in all climates.

It is known that certain peculiarities of organization, which have taken place accidentally or in consequence of the long continued influence of climate, of nourishment, of habits, or of many other unknown circumstances, may be afterwards perpetuated by generation; so that it is possible there may originally have been only one human species, and we are disposed to believe that it was exceedingly beautiful; but the man of nature, like the pear-tree of nature, was a wild being, successively improved by culture and grafting.

96. In my opinion, it would be difficult to determine,

termine, at present, which was the first breed of the canine race ; and I do not think that any one ever ventured to say, that we may see it in the finest dog of the Danish breed. The finest and most beautiful dogs and horses resemble the cultivated pear-tree and the civilized man.

The promptitude with which all those species or varieties of dogs which we daily see have been produced, is a circumstance very remarkable. A moment's reflection on the causes which concurred to produce them will furnish valuable facts, for enabling us to comprehend what may take place by the effect of crossing breeds.

In a large city, such as Paris, there is an immense multitude of dogs of all kinds, which are modified in a thousand ways by varied mutilations, by the use made of them, and by the kind of life to which they are subjected, &c. These dogs are always wandering about, and copulate without regard to colour, size, or quality. These continual mixtures, so often repeated, have produced numerous species and varieties, the primitive types of which it is now impossible to distinguish. Among these numerous species, some remarkable for the greatness or smallness of their size, their plump or slender form, and the great variety of their colour, have soon been observed. It would be remarked, also, that some of them shewed more  
3 aptitude

aptitude for certain things, and greater intelligence in certain exercises. Those which people wished to procure would then be separated, and made to copulate with their fellows; the qualities for which they seemed to have the greatest aptitude would be cultivated; and in this manner would be obtained the shepherd's dog, the different dogs for hunting, and even small lap-dogs. The same number of species are not to be found among horses, because the breeds have not been crossed in so varied a manner.

By continued copulation between select individuals, that apparent equality which seemed to prevail between those of the same genus is soon destroyed; and every fine species, susceptible of being preserved without alteration, when care is taken that they may not be degraded by any mixture with individuals of an inferior quality, are obtained. These fine species really form noble breeds; and it is always observed, that it is chiefly by the females that the qualities of these fine breeds are perpetuated.

Thus, in Arabia, between Bagdad and Bassorah, several breeds of horses, distinguished by characters well known to amateurs, are carefully preserved, without any mixture. The birth of the individuals produced from these breeds is attested by a public act, which particularly mentions all  
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the maternal genealogy, and serves as a patent of nobility to the animal ; but this nobility is transmitted and preserved only by the females, the nobility of the males being merely individual \*.

Species still finer would, in all probability, be obtained by crossing the most distinguished breeds ; for by preserving them without mixture, they are not only prevented from being improved, but must even be sensibly altered in the course of time, in consequence of many particular circumstances.

But, however this may be, all these ideas, in regard to the nobility of horses, are much more rational than those which serve as a basis to the nobility established among animals of a superior order.

97. Among men analogous circumstances have produced similar effects. The inhabitants of the different countries have been slowly modified by the influence of climate, nourishment, exercise, habits, civil and religious customs, &c. When the population in a district became too numerous, men united in society, and when they attained to a certain degree of civilization, they attempted emigrations, and made war on distant tribes, who by

\* See *Journal de Physique*, tom. 1.



circumstances, often very different, had been modified in another manner. Individuals of different varieties would thus be united, and their mixture must have produced a new species. Events of this kind were so often renewed, that the numerous species and varieties now existing must have been the necessary result. But among these different species, some were found to possess a very evident superiority of organization, and shewed a more rapid progress towards improvement: others retained remarkable characters of inferiority and degradation; some also seem to have been checked by circumstances of climate, food, dress, &c. and are nearly in the same state as that in which they existed a thousand years ago.

Among the different races of men, there are three, in particular, which exhibit very distinct characters and a very remarkable organization.

1st. The white race, which have a white skin, tall stature, head oval, cranium well expanded, the nose lengthened, the facial angle eighty-five degrees, the hair fine, commonly of a chestnut colour, and which are in an advanced state of improvement.

2d. The tawny race (Mogul), which have the skin of a copper-yellow colour or tanned, the face broad, the eyes a little towards the sides, the cheek bones projecting, the nose flat, the chin sharp-



sharp-pointed, the hair thick, flat, and black, stature short, cultivation less advanced. This race inhabit the greater part of the globe, and are found in almost all climates; but more particularly in a great part of Asia, in America, in the islands of the South Seas, and as far as the frigid zones.

3d. The black race, which have the skin of a jet black colour, the stature long and slender, the hair short and woolly, the forehead flat, the nose flat, the jaw bones projecting the lips thick, a great mobility of face. They inhabit Africa.

The colour of the skin, which furnishes the most striking character of these three races, may have been the result of the long continued influence of climate; but, in the course of time, it assumed an organic character, which is preserved without alteration in all latitudes.

98. The most remarkable phænomenon in the act of reproduction is the tendency which the generating individuals have to transmit, not only the peculiarities of their organization, but also a disposition to certain diseases to which they were subject, or an aptitude for certain faculties, which they had acquired. This property daily contributes to the degradation and improvement of the species according to alliances.

It is of importance to repeat, also, that the influence of the mother is more remarkable on the essential and interior organs of the child; that the influence of the father appears chiefly in the exterior and accessory parts; and that, in general, the species is improved by crossing the breed.

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## RECAPITULATION

### OF THE KNOWLEDGE ACQUIRED IN REGARD TO THE ORGANIC FUNCTIONS.

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99. **THE** vital power, like that of affinity and attraction, is universally diffused. It is completely exercised only on organized bodies at a certain degree of thermometric, hygrometric, and electric, &c. temperature; and by a continuity of action on slips or fecundated germs arising from these bodies.

When an organized body is thus properly subjected to the vital power, it passes through a series of phænomena which conduct to a sort of maturity. At this period, its parts, which are no longer in a proper relation of organic structure, remain completely subject to the power of affinity, which combines them according to its peculiar manner, and causes the remains of its decomposition to return into the general grand circulation.

Organized and living bodies are not completely free from the influence of the force of affinity; but the latter being less powerful than the vital action, does not begin to manifest itself by any

phænomena of decomposition, until the vital power becomes too weak to retain the *moleculæ* of matter in a proper state of organic structure.

The structure of every organized body seems to consist in a vascular reticulation, in the midst of which matter, by circulating, may assume that indefinite degree of divisibility, necessary for maintaining the phænomena of nutrition.

Those organized beings which appear to be simplest, such as vegetables and zoophites, have at least systems of nutrition and of reproduction. These two systems are not concentrated, but multiplied and disseminated throughout all their different parts. This disposition permits these beings to be divided into several portions, which increase and multiply separately.

But in proportion as we ascend towards beings of a more compound organization, it is observed that the systems of the organs increase, that they cease to be multiplied, that they are concentrated and distinct, and that the living body can no longer be divided without perishing. Of all animals, man appears to have the centres of his organs most closely connected.

In living bodies the vital power causes particular functions, which depend on their organic mode of structure, to be executed; but it maintains in them all a common and uniform action, which

which constitutes the essential phænomenon of life. It is indeed observed, that all the molecularæ of matter which compose these beings are in a continual state of motion, during which they are driven off, and their place is gradually supplied by others, which assume a different arrangement, remarkable at the different periods of their life.

The extreme degree of divisibility or decomposition to which matter may be brought in the organs; its conversion into the proper substance of these organs, the place of which it continually supplies with different modifications, are phænomena, the mode of which is unknown to us because it escapes our observation.

If we reflect, for a moment, that we observe animalcula not more than the two or three hundredth part of a line in magnitude, which are generated, increase, move, and reproduce themselves; that it is probable that in each point of the organization of these beings changes are effected, in a manner analogous to those of the greatest living bodies; that it appears that matter in both assumes the same degree of divisibility, and that nutrition is performed with organic instruments of the same size, it may readily be conceived how far our eye, armed with the best instrument yet known, is from being able to penetrate thither in order to observe what is taking place. Thus, the phænomenon of nutrition is



concealed from us in that infinite minuteness, which is beyond the reach of our coarse organs, so that we are acquainted only with the results of that operation.

Living bodies, independently of their organs of nutrition, are provided also with parts specially destined for receiving the impression of external objects. These systems of the senses, the form of which varies, always constitute an organ of touch, more or less extensive and delicate; and this organ is constantly found even in plants.

Every organized being has the power of placing itself, in the surrounding medium, in that position which is most favourable to its organization; and it is indeed observed that vegetables push their roots towards the moist earth, and turn their stems towards the light; as animals search for those substances which are properest for their nourishment.

A state of suffering or of ease is remarked in all living bodies, and even in plants: to the observing naturalist, the appearance of a vegetable which suffers, or which acquires a vigorous development, is as expressive as the cry of satisfaction or of pain emitted by an animal.

When the functions are not performed in a proper manner, for want of those things which are necessary to the support of life, there takes place in the organization a state of change, which  
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constitutes the painful sensation: it is the first which animals seem to experience.

This sensation of uneasiness or of *want* excites animals, in an irresistible manner, to *action*, for the sake of their own preservation, and for the propagation of their species. The sensation of ease which they experience, in satisfying this want, becomes afterwards a stimulus, which excites them to the repetition of the same act.

The action of foreign bodies on the organization may produce a change of state analogous to want, and thus give rise to a painful sensation, which the animal is powerfully incited to free itself from.

In proportion as an animal expands, experiencing alternately painful and agreeable sensations, it becomes fit to appreciate slight and transient changes of state, which in some measure are indifferent to the order of the functions. Every thing that strikes the organs of the senses may produce sensations of this nature.

In animals, the organic systems, by habitual exercise soon contract a great aptitude for discharging the functions peculiar to them. This aptitude is still increased by the reciprocal aid which they lend to each other in their individual and simultaneous action.

The faculty which the organs have of receiving external impressions, capable of producing a  
change

change of state which constitutes sensation, is an organic function, which by exercise and the force of habit becomes still susceptible of being performed with more facility or speed.

Thus a sensation produced several times in an organ of the senses, by the impression of an external body, may be afterwards completely renewed, without the presence of that object, merely by that of any accessory circumstance, which accompanied it and which is renewed. From this it results, that the sensations experienced are not entirely lost, though they be effaced, since they can be thus renewed by accessory circumstances, and even be recalled in succession, according as they are more or less intimately connected. This faculty, which is observed in all animals, in a greater or less degree, furnishes the principal means of improvement.

An animal, indeed, which is continually excited to *action*, in order to satisfy its wants, and whose past sensations may be repeated in consequence of new sensations, finds itself possessed of sufficient means for *comparing* these different sensations, for *combining them*, and for thus forming a *judgment*, in consequence of which it determines to act in a manner best suited to its preservation.

If to this be still added, that the animal has a strong tendency to act by imitation and by the force of habit, and that the modifications which result from

from the varied use of these faculties may be transmitted, at least in part, by the way of generation, we shall have the sum of the means which concur to the production of organic phænomena, and which tend to the progress of improvement. Every animal, indeed, is susceptible of individual improvement, more or less extensive, and in this manner acquires a sort of experience.

100. The different systems of organs in man, taken together, form a being, who can move from one place to another, and place himself in relation with every thing around him. His organs of the senses render him sensible to the impression of the light, either direct or reflected; to that of the air in a state of vibration, and of odorous and sapid *moleculæ*; and to the contact of all bodies of a certain mass and density. By means of a very extensive system of organs, he assimilates to his own substance atmospheric air, water, and all materials arising from organized bodies. In the last place, he reproduces himself, by the course of a collection of parts, which are in two separate individuals.

All these systems of organs, exceedingly various, are essentially formed of vessels and nerves, having common centres on which their continual action depends; so that the organization is composed of



of parts, which constitute a whole necessarily continued. The vessels and nerves, by their varied and numerous intersections, form different tissues of organs.

The interior parts of the vessels and the cells, resulting from their different tissues, contain serous and sanguine fluids ; albuminous, gelatinous, adipose, saline, &c. substances ; and, in general, every organic material of which the vessels and nerves themselves are formed. All these substances are continually penetrated and traversed by electricity, light, caloric, &c.

Each point of the organization may be considered as a secretory organ ; the parts in their continued action experience a change of state more or less remarkable : after having acquired their full development, they gradually lose their pliability ; matter is accumulated in them ; the continued motion of secretion and absorption is no longer performed with the same activity ; the organic molecules move in them only in a slow manner, and at length arrive at that state of rest which constitutes death.

The whole of the organization may thus be conceived as confined to a life merely vegetative or animal, in which each point arrives at a certain degree of development, of maturity and death, by a continuity of motion and secretion. Thus,  
in



in some cases of very extensive palsy, attended with imbecility, man is reduced to an analogous existence, entirely deprived of relative life.

In this case, the existence seems to be maintained only by the ganglions of the trisplanchnic, by means of the nerves of that apparatus, which accompany all the vessels, and which are distributed to the principal organs, not subject to the empire of the will.

But each point of the organization, independently of its particular life, enters into the composition of a system, which performs its functions only by means of the particular nerves which proceed to it from the brain, or from its vertebral prolongation. In a word, the simultaneous action of the different functions produces the beautiful phænomenon of the human organization.

In this phænomenon, it is of importance not to forget, that each organ is essentially an instrument of secretion; and that in the exercise of this function, the arteries supply the materials and the nerves the principle of action. The heart and the arteries, by their continual contraction, propel the blood to every part of the body; this movement is maintained by the presence of the blood in these parts, and by the influence of the nerves which are distributed to them. The cerebral organ, being itself an organ of secretion, requires for the exercise of its function a continual

nual supply of arterial blood ; so that these two principal organs of life have evidently a mutual dependence on each other.

The organs, in consequence of the different excretions, are continually sustaining a loss : this loss is repaired by means of substances conveyed to them from without ; and for this purpose the organs are in relation with all external bodies. Hence it is observed, that they are differently affected according as the objects which strike them are favourable or hurtful to the whole phenomena of the functions.

In man, as well as in animals, the change of state which takes place in the organs, by the impression of objects, which tend to disturb or to maintain the order of the functions, constitutes the painful or agreeable sensations. The impressions he receives may be completely renewed, without the presence of the object from which they were first received, but only by that of some accessory circumstances connected with it. By these means, he acquires the faculty of avoiding objects which have produced in him sensations destructive of his organization, and of placing himself in circumstances favourable to his preservation. The combined exercise of these first faculties, and the extension of them, give rise to the development of the understanding.

The systems of organs are of three orders : 1st.

Of

Of relation : 2d. Of nutrition : 3d. Of reproduction.

101. Man, in consequence of the structure of his limbs, transports himself from one place to another ; removes from objects which hurt him, and approaches those which are favourable to him.

Of all the mammalia, he has, without doubt, the most advantageous form, as properly speaking he is the only biped, which enables him to preserve with facility a vertical position, by placing the whole sole of his foot on the ground, and extending completely his ham. His pelvian limbs are provided with large muscles, and the swelling or dilatation produced by these muscles exclusively in him, add to the beauty of his shape and to the strength of the parts.

The thoracic limbs are not impeded by walking ; and may be employed for the noblest and most important purposes.

His head is almost in equilibrio on the vertebral column, and his eyes are turned directly forwards.

The disposition of the muscles allows the limbs to perform the most varied and most extensive motions ; and it is astonishing to see with what force and agility these motions are performed by some persons, in consequence of a peculiar organic disposition and proper exercise.

The strength and pliability of tumblers, the lightness and agility of dancers, the surprising quickness of the fingers of the organist, are always the more astonishing, as the anatomical structure is not sufficient to account for it.

The muscular strength, displayed by some individuals of an athletic conformation, and the violent action of the muscles in certain states of passion or of disease, evidently show that an explanation of the phenomena of life are not to be sought for in the laws of natural philosophy. Meagre and debilitated females are often seen to break the strongest cords, and to drag after them enormous masses, during paroxysms of hysterics, or of mania. A muscle may then overcome a resistance by which it would be broke in the state of death.

The muscular system absolutely requires employment: it appears to be that which consumes, in the manner most proper for health, the quantity of that principle of action which the brain distributes to every part of the body by means of the nerves. The habitual inactivity of this system always produces greater or less derangements; it is one of the most frequent causes of the chronic diseases which prevail among the idle classes in large cities. The habitual exercise of the muscular system consumes the strength more than that of any other; and therefore



therefore men continually employed in severe labours are the least proper for any other function.

The muscles, like the other organs, have a great tendency to exercise the function peculiar to them, at the same time, in the same manner, with the same degree of intensity, and in consequence of the same recollected objects: this constitutes habit.

The tendency to habit, which allows the repetition of the same actions with more promptitude, address, and facility, is one of the great causes of improvement.

102. As the organs of the senses bring us into a more direct relation with the surrounding objects, these objects, by their varied action on our organs, unveil to us a part of their properties.

103. Man sees illuminated objects of a certain size, and at a certain distance, by means of an organ, the construction of which is similar to that of the camera obscura. The luminous rays reflected from objects and refracted by the humours of the eye, proceed to the retina, and there trace out the image of it, in an inverted position.

The sensation which the individual experiences by the impression made on the retina, is not that of an image painted in the bottom of the eye; for in that case another eye would be necessary to look at



it; nor of an object inverted which it places in its proper position; for he has no idea of up or of down, nor of right and left of his retina; but a sensation of touching, which results from the contact of the different luminous points with the retina, in an order determined by the form of the object.

The sensation of sight is the most important, since it brings man instantaneously into relation with very distant objects; but it is also the most uncertain sensation.

Sight indicates only the form and colour of bodies: it is by approaching and touching them that we can judge of their distance and magnitude; and, notwithstanding our daily experience in this respect, it often leaves us in a state of uncertainty, from which it is impossible for us to free ourselves.

The rays of light, in their progress to the eye, follow all the common laws of dioptrics; and there is no difference between the eye and an achromatic telescope, except that the former is a living instrument, susceptible of being moved in every direction, and of being lengthened or shortened to change its focus.

At the moment when the impression of the rays of light on the retina begins to be felt, the eye can no longer be compared to an optical instrument. It is not because an image of the object is painted

painted in miniature on this nervous membrane that we have a sensation of it; but because in painting itself there, each luminous point produces an impression of contact, which is communicated to the common centre of sensations in a particular order, and with a degree of intensity which varies according to the form of the bodies and the reflecting property of their surface: in this respect the excessive sensibility of the retina is inconceivable.

The organ of sight seems to have a more extensive field of view in carnivorous birds than in man.

104. The organ of hearing consists essentially of a nervous pulp, which perceives the contact of the air in a state of vibration. This pulp is found in the midst of a viscous fluid, contained in the membranous labyrinth.

The membranous labyrinth is enclosed in an osseous labyrinth, formed in the petrous portion of the temporal bone. It communicates with the tympanum by two apertures, one of which is closed by a membrane, and the other by a small moveable bone.

This small bone is articulated with three others, the last of which is applied to the membrana tympani, and adheres to it. These small bones have attached to them the muscles by which they are

moved; and they stretch the membranes to which they are affixed.

The *membrana tympani* separates the *tympanum* from the auditory conduit, which terminates in the exterior part of the ear.

All this apparatus, which is very complex, seems destined to facilitate the entrance of the vibrating air into the ear, as well as its contact with the nervous pulp of that organ, and of securing the latter from violent and abrupt impressions.

The impression made on the expansion of the labyrinthic nerve, by the contact of the air in a state of vibration, is continued to the brain, and produces in it the sensation of sound.

The sensibility of the nervous system, which appreciates all the modifications of the air in a state of vibration, is no less exquisite than that of the retina, which perceives refracted light; and it is difficult to conceive how the ear can be so delicate as to enable the musician to distinguish several intermediate degrees between two tones.

105. The system of smelling consists in a membrane of a mucous nature, susceptible of being affected by the *moleculæ* of certain bodies held in solution, or in suspension in the air.

The strength of smelling seems to be in the ratio of the extent of the olfactory membrane: in  
some

some carnivorous animals this sense is exceedingly acute.

106. The organs of taste are contained in a mucous membrane, which perceives the impression produced on it by the contact of the *moleculæ* of certain bodies, and particularly of those which are soluble in water.

The organ of taste and that of smell, in man, are far from perceiving the impression of all the *moleculæ* of bodies which come into contact with them: there are even many which have a very great action on the nervous system, and whose contact with these organs produces no sensation. The most violent poisons are frequently insipid; and the air charged with miasmata, which produce epidemic diseases, is often inodorous.

The systems of the senses, of which we have here spoken, are evidently organs of touching; they however differ from that of touching, properly so called, in this respect, that the latter receives only the impression which results from the resistance, temperature, and form of the bodies; while the former experience impressions, which depend on other properties of these bodies.

All parts of the body are susceptible of being affected by the contact of foreign substances, and must be considered as organs of touching; but

that which seems really to deserve this appellation is the hand, as its structure allows it to accommodate itself to the form of all bodies, and to examine with ease all their prominences. The skin of this part, by the continual exercise of touching, acquires a great aptitude for perceiving the slightest changes in the form, the consistence, and the temperature of bodies. How far the delicacy of this organ can be carried, when not distracted by the sense of seeing, and when continually exercised in a proper manner, may be observed, in particular, in some blind persons.

As every part of the organization is susceptible of being affected by the contact of foreign bodies, in this point of view they may all be considered as organs of the senses.

The difference which exists between the various parts of the body, depends on the functions which result from their organic structure, and from the nature of the nerves distributed to them; according to these differences, the organs answer, different ways, to the impressions made on them.

When a change takes place in the state of an organ, in consequence of an impression received, this change is always manifested in the particular exercise of the function of that organ, which may be increased, diminished, or altered.

Bodies which lessen the action of an organ may  
be



be called *debilitants*; those which increase it may be distinguished by the appellation of *excitants*; and those which alter it may be called *irritants*.

107. The action of the numerous substances, susceptible of affecting our different organs, produces phænomena exceedingly various.

The impression may be confined to the part which is touched, or be propagated to the centre of the nervous action. If it be confined to the part touched, it produces only a very slight and transient change of state, which takes place, as we may say, without the knowledge of the rest of the organization. If it be transmitted to the centre of the nervous action, the change of state which thence results may occasion a sudden sensation, or produce none capable of being appreciated.

In the last place, the result of an impression received by an organ may be specially manifested, either in the part affected, or in a distant organ, or in the whole of the organization.

But to convey a better idea of these different modes of affection, we shall here illustrate them by examples.

Slight local affections, altogether indolent, and which seem to have a relation only to the part which exhibits them, often take place.

Every strong and unusual impression on a part which receives nerves from the encephalon, or its

vertebral prolongation, gives rise to a sudden sensation.

But if the affection takes place in an organ to which no nerves proceed from the encephalon or its prolongation, the impression may still be received, and produce in the organization a change of state, often very considerable, without the individual experiencing at first any very sensible sensation. Almost all catarrhal diseases begin in a similar manner; the action of the virus which produces gonorrhœa is not felt in the urethral membrane at the moment of infection. Most epidemic, contagious, and eruptive fevers, and several kinds of asphyxiæ, produced by the action of miasmata conveyed into the ærian passages, belong to the same class.

An organ may be affected also by a body, without being directly struck by it, in consequence of the communication established between the nerves and every part of the organization: thus friction with mercury excites secretion of the salivary glands, without exercising a perceptible action on the skin.

From these different considerations it results, that an organ answers to different *excitants*, in the ratio of the function peculiar to it; of the nerves which are distributed thither, and of the nature of the excitants.

When a muscle is irritated, it answers by  
motion,

motion, as a gland does by the product of secretion.

The systems of organs which receive nerves from the encephalon or from its rachidian prolongation, are easily excited, and experience a lively and sudden sensation. Those which have their nerves only from the ganglions of the trisplanchnic are sensible in a weak manner to the impressions received.

When a system of organs, easily excitable, is stimulated in a manner proper to the exercise of that function, the result is a sensation of ease; if the irritation is of such a nature as to disturb the order of that function, the sensation is painful.

Organs habituated to painful and agreeable sensations, perceive also simple ones, which are, in some measure, indifferent to the organic order. In a word, the uneasiness experienced by organs when their functions stand in need of being exercised, and that which results from various internal derangements, are so many particular sensations.

An organ reacts with the more facility on an irritant, when it has already received the impression of it several times. Thus the mucous membrane of the ærian passages is easily affected, when it has already experienced frequent colds.

The case is the same with the systems of the senses: the impression produced on them by external objects, is repeated with more facility, when they

they have already been subjected to them several times.

Hence, the organs of the senses, the organs of motion, and those even of the different secretions, acquire, by habitual exercise, a great aptitude for repeating, with facility, the acts peculiar to them, in consequence of the same excitants.

This force of habit, in regard to the repetition of the same acts, becomes so great that a *direct sensation*, produced by an object, may be entirely renewed, without the presence of the object by which it was originally communicated, but only by that of some circumstances connected with it.

The combination of *direct sensations* with *recollected sensations*, or *ideas*, is at first produced by the irresistible impulse to *act*, in order to withdraw from pain, and to satisfy wants. An aptitude for combination may then be extended to objects less necessary for preservation.

It is the extension of this power of combining sensations, which gives rise to the development of the intellectual faculties. In a word, it is by the almost exclusive employment of this faculty, that man attains to the highest degree of intelligence.

The particular history of the development and extension of the intellectual faculties must be founded on physiological knowledge, which can alone afford a rational basis and fixed point of departure to the metaphysician.

108. The changes, which are continually effected in every part of the organization, constitute nutrition, properly so called. The blood furnishes the materials necessary to the exercise of this function.

The blood, during its continual circulation, is distributed by the arteries to every part of the body; it then returns by the veins and lymphatic vessels, to repair its losses, to resume its former qualities, and to be fitted for a new circulation.

The blood repairs its losses, at the expence of the product of digestion: it frees itself from its excess of aqueous parts by urinary excretion; it resumes its former qualities by its passages through some glandulous organs, and particularly through the lungs. In the last place, the elevated temperature of the lungs, which is the result of the phenomenon of nutrition, is maintained by means of the cutaneous organ.

The blood, propelled from the left side of the heart, issues through the aorta, and distributes itself, by the arteries, to every part of the organization, to which it conveys the arterial blood, the common principle of all secretion.

The blood, in this passage, having experienced a *loss* and *alteration*, more or less considerable, returns by the veins and the lymphatics.

The chyle, which mixes itself with the venous blood,



blood, to repair its losses, is the product of digestion.

Digestion comprehends the phenomena exhibited by the aliments introduced into the digestive system, from the time they enter the mouth till the period when they issue from the body, at the extremity of the large intestines.

The alimentary substances, which are always procured from animals or vegetables, are masticated in the mouth and penetrated by the saliva. By deglutition they are conveyed along the œsophagus into the stomach, where they are mixed with new juices, and by the action of the stomach and their residence in a living organ they are transformed into a chymous pulp. The aliments then pass into the duodenum, where they are penetrated by the bile, the pancreatic liquor, and the intestinal juice, and are transformed into a homogeneous substance, which contains the chyle.

While this substance is proceeding along the intestines, the mouths of the numerous chyliferous vessels, with which their sides are covered, absorb the chyle it contains; and when it reaches the extremity of the large intestines, the residuum of the digestion is thrown out.

The absorbent vessels of the chyle proceed, after a short passage, into the glands of the mesentery, where the chyle still experiences a particular change,

change, and then issues from these glands by larger and less numerous vessels, which proceed into glands of a still greater size. At length, these chyliferous vessels are confounded with the lymphatics, and terminate along with them in two thoracic ducts, which proceed into the subclavian veins: the left thoracic duct is always much stronger than the right, which is sometimes wanting.

Such are the phænomena of chylous absorption, perceptible by the sight; but it is very probable, that those which escape our researches are much more important and extensive.

There are several reasons for believing that the whole product of digestion does not proceed into the subclavian veins, but that a part is directly mixed with the blood in some other way.

The transformation of the aliments into a homogeneous pulp, has at first a resemblance to a chemical operation: it however differs from it in many points of view.

When vegetable substances, whether green, ripe, or already putrid, and animal substances, either raw, boiled, or even in an advanced state of putrefaction, are introduced into the stomach, the action peculiar to them is immediately suspended; their fermentation or putrefaction is checked, and the vital power makes them pass through a series of phænomena, the result of which is the formation

tion of a chymous pulp, that in the same animal always contains chyle of the same nature.

Dupuytren, in his ingenious experiments on the chyle, tried to communicate colour or smell to this fluid, by mixing with the aliments colouring and odorous substances of every kind, mineral, vegetable, and animal, but his attempts were fruitless, as he was never able to produce the least sensible alteration.

When the gastric system enjoys its full vital energy, none of the phenomena peculiar to the fermentation and putrefaction of animal or vegetable substances are observed.

But if this system is gradually weakened, phenomena which evidently belong to the laws of chemistry are manifested. There are then observed a disengagement of carbonic acid gas; of sulphurated and phosphorated hydrogen gas; of gaseous oxide of carbon, &c.; the formation of acids and alkalies; and, during some diseases, the smell of the fæces indicates a very evident commencement of putrefaction in the intestines.

Digestion is necessarily a very important function, since it comprehends the action of the mouth and of its glands, of the œsophagus, of the stomach, of all the intestines, of the liver, of the spleen, and of the pancreas. All these organs exercise an almost simultaneous action, and with a great exertion of power. Hence it happens that  
people

people after meals experience so often drowsiness and fatigue.

Children, who in general are exceedingly voracious, sleep when their stomachs are full ; and it is observed that great eaters generally take a nap after dinner.

As digestion affords a very lively mode of gratification, it was natural for men to make this function a source of pleasure ; and it is indeed remarked, that the table, among all nations, forms one of the greatest sources of enjoyment.

It may here be observed, that the whole of the organization, in the three orders of organs of which it is composed, exhibits three very different sources of enjoyment.

The first is found in the system of the senses, in conjunction with the intellectual organ ; the second in the digestive organ ; and the third in the organ of generation.

The first order of organs do not become a source of happiness till the period of mature age ; and only among civilized nations, who have given them a proper direction and cultivated the use of them.

The last develops itself at the adult age, often with great force, and imperiously requires to be exercised ; but in old age, the action of the genitals becomes weakened, and is often completely annihilated.



The digestive system affords pleasure at all ages: it is the only source of enjoyment in children, who seem to live only to eat. In the adult age, the intellectual functions and those of the genitals imperiously require to be exercised; the function of these systems, which is then executed with great intensity, renders that of the gastric system of little importance; but in the course of years the stomach resumes the ascendancy, and it is the only enjoyment of many old persons, who appear in various respects to return to the state of childhood, and to acquire again its prevailing tastes.

The intellectual functions are those, in general, which continue longest; they can retain their vigour and even acquire strength during the whole course of life, when properly cultivated and in a continued manner.

It is however observed that a derangement of the principal vital organs always produces a proportional weakness in the intellectual functions.

The object of digestion is to furnish the quantity of chyle, necessary for repairing the losses which the blood experiences in the course of its continual circulation, by supplying materials for different secretions.

In persons who lead a very active life these losses are considerable: cutaneous and pulmonary perspiration, urine, and other excretions are always very abundant. Such persons have an extraordinary



ordinary appetite, and eat a great deal without being incommoded.

On the other hand, there are found in large cities women of an indolent character, brought up amidst luxury and ease, who have scarcely any excretions. All their organs are reduced to a state of inaction and debility, which seems to be a mean term between life and death. These persons have habitually very little appetite, and use only a small quantity of food.

The stomach, like the other parts, is strengthened by exercise; habitual excess of aliments may cause it to acquire great amplitude, and in this manner render it the predominant organ. It is not uncommon to meet with men who eat a great deal, though they take little exercise; the greater part of the vital powers in such persons are employed in digestion. Persons, in general, who are exceedingly corpulent, are seldom endowed with great strength of intellect.

When the stomach is overcharged, it makes a continual effort to digest the aliments which furnish useless chyle. If its weakness be such as to prevent it from effecting digestion, the aliments, being then abandoned to the laws of affinity, become to the alimentary canal a stimulus, which excites vomiting or diarrhoea with violent efforts and dreadful colic. Sometimes they produce spas-

modic affections of different kinds, convulsions, and even death.

Too frequent abuse of the gastric organ and inactivity of the muscular system are the most common causes of the chronic diseases which are observed in large cities.

109. The blood is freed from its excess of aqueous parts and from different saline substances by the urinary system.

The most extraordinary phænomenon which occurs in the function of the veins is, the promptitude with which drink seems to be converted into urine, and particularly in man, who uses a large quantity of it.

The impossibility of conceiving how drink can be so speedily converted into blood, and this blood into urine, has induced some physiologists to believe that there must be some more direct way than circulation for transforming drink into urine; but this hypothesis is not supported by our anatomical knowledge.

The phænomenon of the secretion of urine appears extraordinary, merely because it has not been considered under its real point of view.

The beverages which men use to excess contain, in general, alcohol or acids. These substances equally stimulate the stomach and the kidneys;

kidneys; and the simultaneous action of these two organs maintains the continual excretion of urine.

The stomach, stimulated in a proper manner by the presence of liquors, digests these fluids; and the aqueous part, taken up by the absorbing vessels, becomes speedily mixed with the blood.

The kidneys, stimulated also by the action of liquors on the nerves of the stomach, soon enter into action, and the two large renal arteries do not fail, in a short time, to convey to them blood overcharged with aqueous parts. These two circumstances produce the secretion of urine, which is effected with activity, and the blood frees itself in the kidneys from the water which it receives in excess from another quarter.

It is here seen that the drink, in this manner, is not directly transformed into blood, but that it becomes mixed with it in the state of water, and that it is separated from it by the continued and heightened action of the kidneys.

Physicians, therefore, have reason for saying, that those who drink abundantly *wash* their blood; but it does not clearly appear what the blood can gain by being *washed* in this manner.

Another very surprising phænomenon exhibited by blood, is the promptitude with which it acquires certain odours, after a person has eaten or even inspired certain substances. Every one knows that

urine acquires a very fetid smell after eating asparagus, and that it smells of violets after swallowing turpentine, or only inspiring the essence of it for some time. These instances are commonly quoted, as a proof of the rapidity with which the aliments are transformed into blood; but it is probable that these substances act only as particular stimulants of the kidneys, which produce a change in the mode of secretion of these organs. This change is announced by a peculiar odour, which for the most part is not that of the substance which produces it; for the smell of violets has no relation to that of turpentine.

110. From the different acts of life there results a phenomenon, which forms one of the principal characters of organized beings: namely, that of retaining a temperature nearly constant, whatever be the medium in which they live.

In man this temperature is about 40 degrees of the centigrade thermometer (104° Fahren.): it necessarily results from the action of the different systems of organs, and from the changes which are continually effected in all parts of the body. It may be observed, that in the execution of these different phenomena, the substances which issue from the body have more density than those which enter it; so that the result must necessarily be the disengagement of caloric; and it is to it, in all probability,

probability, that the habitual elevation of the temperature is owing.

Our aliments, indeed, consist of atmospheric air, and animal or vegetable substances, with which we, in general, unite a great quantity of water; whereas the materials which escape from our bodies are, hardened excrements; urine charged with saline matters; unctuous sweat; thick excretions, charged with albuminous, gelatinous, greasy, saline, &c. substances; and in the last place carbonic acid gas. As all these products are evidently more consistent than the materials which served to furnish them, the transmutation of the latter, which is continually effected in every part of the organization, must necessarily be accompanied with a disengagement of caloric.

It is the air, in particular, digested in the lungs, which is the substance most proper for furnishing caloric; and it is indeed observed, that the caloricity of animals is greater, according as the system of respiration is more extensive, and as the exercise of that function takes place with more activity.

In an individual who uses violent and continued exercise, all the secretions are accelerated, and the disengagement of heat becomes considerable. Perspiration, which is then proportioned to the quantity of caloric disengaged, carries off the excess of heat; the temperature of the body is lowered, and



remains at the same degree, by means of the cutaneous organ, which thus becomes the regulator of caloricity.

When a man is exposed to a very high atmospheric temperature, he feels himself oppressed; he experiences a strong tendency to repose; has no appetite, and is thus in a state which disengages very little caloric. At the same time the cutaneous organ, being strongly stimulated by the external heat, excretes an abundant sweat, the evaporation of which, at the surface of the body, carries off a great quantity of caloric.

In this state the want of alcoholic liquors, and of different stimulants, is strongly experienced. It is almost inconceivable what a degree of heat a robust man is capable of sustaining for some time. But if the heat increases or is maintained, he at length falls into a state of oppression, which may become mortal.

On the other hand, when a person is exposed to intense cold, he experiences an uneasiness which excites him to motion; circulation and respiration are accelerated; the air he inspires is more condensed; perspiration is almost annihilated; the appetite is proportioned to the exercise, and all the means which produce heat are put into action to maintain the habitual temperature. The degree of cold which a man resists with good clothes, exercise, and spirituous liquors, is no less astonishing than

than the degree of heat he is able to endure. But, if he abandons himself to rest, the action of the cold provokes sleep; and if he sleeps, in this situation, he must infallibly perish.

III. The florid, spumous, arterial blood, which is of a bright red colour, proceeds with rapidity to every part of the organization, by an order of vessels not very tortuous, the sides of which are exceedingly thick. These vessels are divided and subdivided in an indefinite manner, and lose themselves in very minute ramusculi. As they divide, their respective capacity is increased, and the blood circulates with less activity in the rami than in the trunks.

The blood acquires and retains a temperature of 40 degrees of the centigrade thermometer\*, by the result of the different secretions, the materials of which it furnishes: it frees itself from the heat which exceeds this temperature, by means of perspiration; and from its excess of aqueous parts by urinary secretion.

The blood, in distributing itself to all parts of the organization, to supply them with the materials

\*The translator must here observe, that the author in different parts of this work makes the heat of the blood to be 40 degrees of the centigrade thermometer, or 104° of Fahrenheit, which is 7 degrees more than it is commonly supposed to be; as most writers on physiology estimate this heat at 97 degrees of Fahrenheit.

necessary for effecting the different changes which are there continually taking place, undergoes a very manifest alteration. It then returns from the different parts by two orders of vessels, the veins and the lymphatics. The veins convey back the greater part of the blood, that which has undergone the least alteration, and which still retains a brownish red colour. The lymphatics collect the residuums of the different secretions, and in general all the fluids diffused throughout the large cavities, or deposited in the cells of the different tissues.

The venous blood and the lymph proceed slowly in tortuous vessels, the thin sides of which are furnished internally with valvular folds, which prevent the return of the fluids. These vessels arise in imperceptible capillary ramusculi, and their successive union forms rami, branches, and trunks. These vessels, in uniting, decrease in regard to their respective capacity, and the fluids they contain accelerate their progress as they advance from the rami into the branches. In the last place, the lymph receives the product of digestion, and mixes with the venous blood; and the latter, after passing through several organs, returns to the point from which it proceeded, in the state of arterial blood.

The lymphatics, in their passage, traverse the numerous glands, in which the lymph experiences  
a repeated

a repeated assimilation, or sort of digestion, which gives to this fluid characters of vitality, and renders it proper for forming a part of the blood. It is not until they have been thus properly assimilated in the glandulous organs, that the fluids absorbed by the lymphatics pass into circulation. By this disposition the blood can receive none of those foreign substances which it is vulgarly believed can pass into it with so much facility, in order to infect its whole mass.

The venous blood, which returns from the different parts of the abdomen, seems more particularly to be charged with heterogenous substances. The veins which bring it back unite into a large trunk which proceeds into the liver. This blood, in traversing the hepatic organ, frees itself from the adipose and albuminous substances which it contains in excess; these substances, united to a small quantity of soda, form in the bile a saponaceous liquor, the excretion of which by the duodenum becomes one of the most powerful agents of digestion.

The veins of all the parts unite into two large trunks, which convey the blood to the right side of the heart, from which it passes into the pulmonary organ.

It is in passing through this organ, in particular, during the act of respiration, that the blood experiences the most remarkable changes, and

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completely resumes all its qualities of arterial blood.

By the indefinite expansion of the pulmonary arteries, the blood is uniformly diffused throughout every part of the respiratory organ, where it finds itself, as we may say, in immediate contact with atmospheric air, introduced into the bronchial cells, by passing through the aërian canals, the subdivisions of which seem to equal those of the arteries.

During the act of respiration, the blood assumes a beautiful scarlet colour, and becomes spumous, warmer and lighter than the venous blood; the atmospheric air loses a part of its oxygen, perhaps even a little azot, and becomes charged with nearly the same quantity of carbonic acid gas.

In the function of the respiratory organ, it is probable that the part of atmospheric air which is wanting, has been digested and absorbed in order to serve for the general nutrition, and that the carbonic acid gas is the product of the particular secretion which the blood effects in the lungs, as the bile results from that effected in the liver.

In a word, the sides of the bronchial cavities secrete an abundant serosity, which is continually evaporating by expiration, and which becomes one of the grand causes of loss.

112. The air expelled from the lungs becomes



still useful to the organization : this elastic fluid, driven out with greater or less force, may give rise to the formation of sound.

The lungs, which continually receive and expel air, are proper for producing noise. Cries are the first language of pain in all the mammalia; and they afterwards become that of joy and of every other sensation.

Air put into a state of vibration, in its passage through the glottis, produces sound by means of the epiglottis, which acts the part of a pipe.

The fundamental sound is furnished by the larynx, the shortening of which gives the octaves, and the contraction the harmonics.

The varied articulations of speech are produced by the different parts of the mouth.

But these data are far from accounting for the effects of singing and of speech. It may be said that the ærian passages form a very bad wind instrument, which man has found means to turn to great advantage.

It must not be believed that speech, like an ear, is the gift of nature: voice and speech are the result of overcoming a great difficulty; and to this object the progress of civilization has contributed.

The children in civilized nations learn to speak with facility, because they inherit a sort of peculiar disposition for learning the language of their fathers; because all those around them speak and employ

employ every method proper for making them accentuate ; and because the first years of life are entirely devoted to that exercise.

But the use of speech is so difficult to be acquired, that it is scarcely possible to teach it to a child who has passed the first fifteen years of life without hearing others speak.

Singing, perhaps, is attended with less difficulty in the execution than speech ; and if all the means employed to teach articulation were employed to teach modulation to the children of good fingers, there can be no doubt that music would become an art familiar to almost every individual.

113. The reproduction of the human species seems to be effected in a manner analogous to that of all other organized beings. An egg, which consists of its germ and placenta, acquires in the ovarium a certain increase, beyond which it does not proceed, until by the contact of the fecundating substance it has received the impulse of a new life.

At this period it increases, detaches itself from the ovarium, traverses the uterine tube, and fixes itself in the uterus, where it remains nine months. During this time the placenta, which is attached to a part of the sides of the uterus, extracts from it juices, which it assimilates, and which serve for  
its

its increase, as well as for that of the germ, by means of the circulation established between these two parts.

When the foetus has acquired a certain growth, and the placenta has attained to a certain degree of maturity, both are expelled from the uterus by the contractile action of its sides. The child then enjoys a new life, and still remains attached to the mother, for some time, by the need of lactation.

The system of generation seems to be indifferent to and little connected with the whole of the individual organization : during the first years of life it has no influence ; it loses its action at an advanced period, and may be suppressed without great inconvenience : however, when its function is exercised with great energy, it borrows aid from all the other systems of organs, which are entirely subordinate to it ; and each concurs, in its own manner, to favour its action.

The danger of employing this organ has been too much exaggerated ; like all the others, it is strengthened and maintained by moderate exercise ; it is destroyed by long inactivity ; and yet it may, with truth, be said, that by excessive use it is destroyed much sooner than any other organ. This function, highly important, since it perpetuates the species, is one the use of which is excited by the most exquisite pleasure.

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The exercise of this function procures a sensation the more lively, as its duration is short: it can therefore serve only for employing a very small portion of time. Among idle persons, who have acquired a habit and contracted a need of this enjoyment, it is soon destroyed by abuse; and the desire of renewing a pleasure, which they can no longer dispense with, leads to the most extraordinary expedients; and most inconceivable extravagances, the result of an exalted imagination, which varies all its resources, and tries every mean proper for renewing a sensation, become necessary, and for which the organ is more or less completely unfit.

A great many singular things have been said to explain these flights of the imagination, which have been considered as peculiar tastes, natural to some individuals; but they are merely the result of an ever-active desire to reproduce sensations, which have become wants.

At the period of puberty, in persons of a strong constitution, who live in towns amidst ease and idleness, surrounded by objects which excite amorous desires, the organ of reproduction imperiously requires to be employed, and if completely prevented very serious accidents may be the consequence.

No state, perhaps, is more painful, and no situation is worse understood, than that of a person who is continually employed with a want which  
he

he endeavours to repress. This conduct maintains a sort of perpetual irritation in the genital parts, which, in the end, generally produces very severe chronic affections, and particularly among the women.

The only rational and sure means of extinguishing the action of this organ is, to give great exercise to the rest, but especially to the muscular system and the intellectual faculties, which always occasions a salutary diversion, and affords great employment to the vital powers.

The most important consideration, suggested by the system of reproduction, is that which relates to the means it affords of transmitting to children the general, and even the particular dispositions of the parents. This faculty seems to belong to all organized beings ; and is observed in plants as well as in animals.

Experience has proved that there is no alteration or affection, no physical disposition or aptitude for certain intellectual qualities, which are not more or less susceptible of being transmitted by generation.

Reproduction exhibits also one of the grand means of the improvement as well as of the deterioration of the human race. In this respect, it must always be remembered that children, *cæteris paribus*, have a greater resemblance to their mother, in the essential and fundamental,  
interior



interior parts, and to the father in regard to the accessory or superficial parts.

114. Life and health are the essential result of a proper action of the different functions. Under this point of view, it is proved by experience and observation that the organs are strengthened by moderate and habitual exercise; that they are weakened by repose or forced exercise; and that the weakness or derangement of a function has always a greater or less influence on the whole of the organization.

From our knowledge acquired in regard to the organic structure it results, that the best combination of the powers for rendering the organization most conducive to the happiness of the individual, and to the progress of civilization, is when children receive an education founded on a proper development of the physical and intellectual faculties, and the study of the exact sciences, and when they pursue the same object during the remainder of their lives, by directing their attention to one part of science or of art, which they endeavour to improve.

## CONCLUSION.

115. MAN enjoys a certain number of faculties, the combined employment of which render him susceptible of indefinite improvement.

1st. He is provided with organs of loco-motion, nutrition, and reproduction.

2d. He is in relation with external objects by means of the organs of the senses.

3d. He is excited to act and to exercise his different functions by the stimulus of pain; and induced to satisfy his wants by the desire of obtaining ease.

4th. The sensations he experiences may be renewed, without the presence of the objects which at first produced them, but merely by that of objects which were connected with the first, and which recall them.

5th. The organs are strengthened by exercise, and by repeated action acquire a great tendency to habit.

6th. The peculiar dispositions of the organization are transmitted by generation.

In the exercise of his faculties, it is observed, that man is irresistibly excited to act, for the sake of his own preservation, and for the propagation

of his species; that he continually experiences direct sensations, which recall others, and that he is forced to *combine direct sensations with recalled sensations*, to deduce from them results favourable to his preservation.

The faculty of *acting* and *combining*, for his preservation, may have been afterwards extended to the factitious wants which were successively created.

This faculty acquires great extent among men who unite together in society. During the slow progress of civilization, they are gradually seen to increase their means of existence and of happiness. They substitute artificial for natural signs; they employ their cries as signs, and gradually transform them into language. By little and little they acquire the habit of more continued attention.

The continual employment of factitious signs gives great extent to the faculty of having recalled sensations. Through the necessity of providing for urgent wants, and satisfying ardent desires, man soon forms combinations, more or less extensive, of the sensations which he experiences. The propensity to rule is gradually changed into a desire of obtaining respect. In a word, among men in a state of civilization, who find themselves without employment, amidst all the means of existence, this desire of respect, and the neces-

fity of obtaining new sensations, which always becomes stronger, makes all the faculties acquire an extension, which increases as the product of their combination.

Under these favourable circumstances, man becomes a being who has no resemblance to his original type: the point from which he set out can no longer be discovered; the path which he has pursued can scarcely be traced out; and his new moral existence seems to be altogether divine.

THE END.

### ERRATA.

Vol. I. page 373, line 10 from the bottom, for *tracheal artery*,  
read *trachea*.

Vol. II. page 147, line 5 from the bottom, after the word *successful*, add *hooping cough*.

page 291, line 8 from the top, for *synoche*, read  
*synocha*.

page 398, last line, for *obstipité*, read *obstipitas*.

page 206, line 2 from the bottom, for *mammilla*, read  
*breasts* ; and,

page 207, line 4 from the top, for *mammilla*, read *breast*.















